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Vol. 22. 218 WILLIAM STREET, NEW YORK. No. 17.

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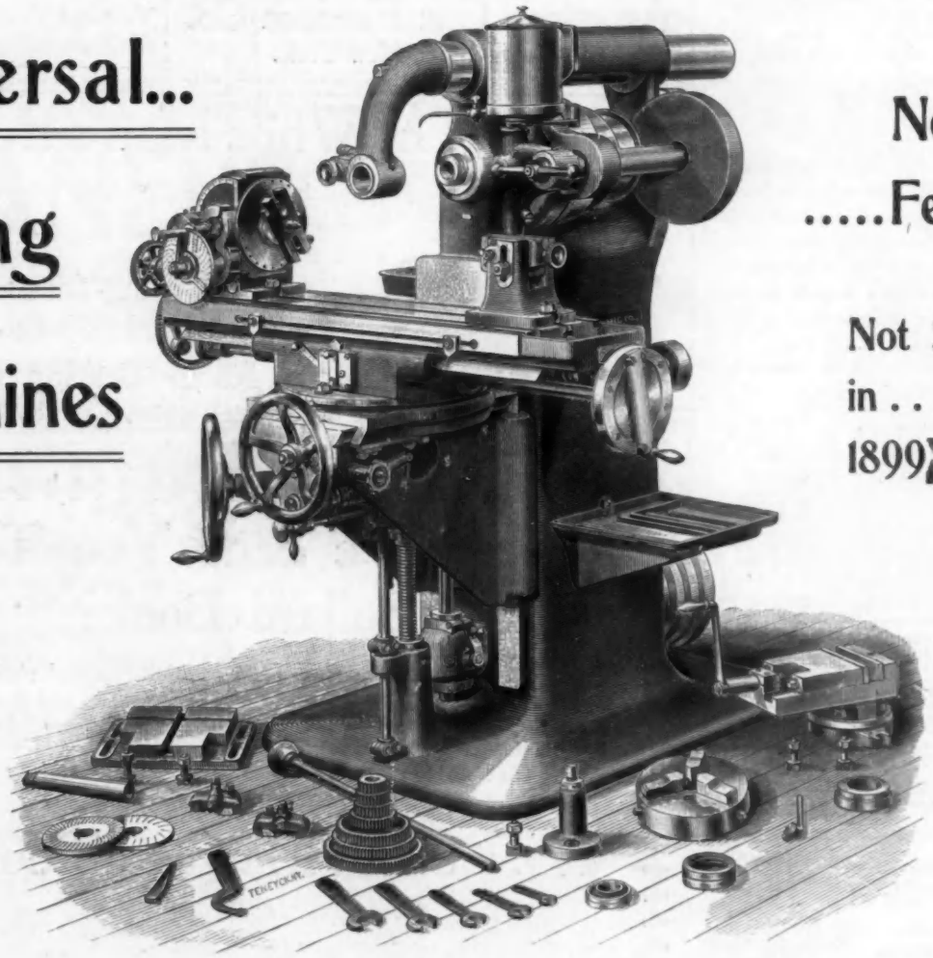

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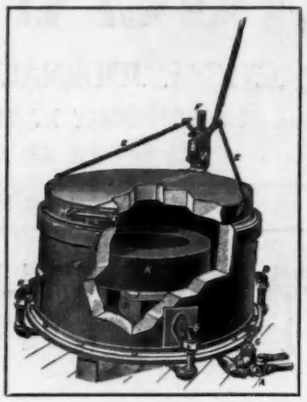

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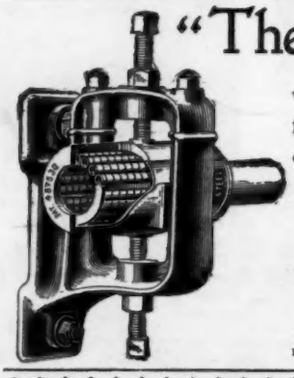

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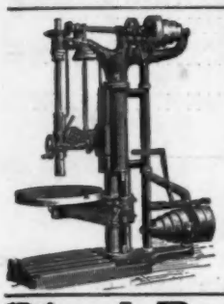

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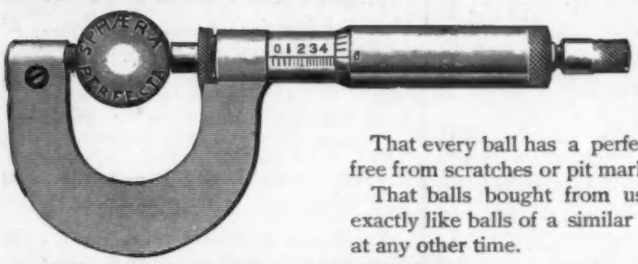

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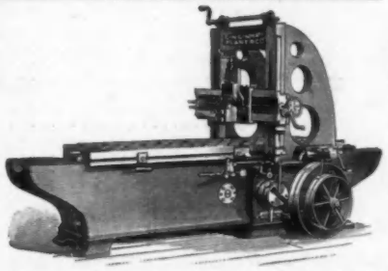

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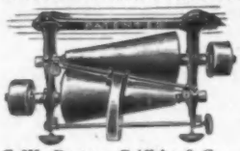

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AMERICAN MACHINIST

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The Changes in the Scope of Mechanical Engineering.

In another column will be found the programme for the Washington meeting of the American Society of Mechanical Engineers. The meeting cannot fail to be an enjoyable one for those who attend, and the ostensible purpose of the gathering should also be subserved, to the practical benefit not only of those who participate, but of the entire society and of the engineering world. It is too early yet to say anything of the substance of the papers to be presented, as copies of them have not yet come to hand; but of the subjects to be considered there is some opportunity for remark. These successive semi-annual presentations of matters mechanical, without previous suggestion of topic, are quite apt to give us some idea of what is at the period most prominent and novel in mechanical practice, and most occupying the thoughts of the mechanical world. The suggestion of the present list is not so much of what is now most prominent and engrossing as of the things which have ceased to be so. The topics which have been most insistent in nearly all of the preceding transactions of the society are now conspicuous only by their absence. We have here no discussions of steam engine efficiencies, nothing of the comparative merits of the compound and the multiple expansion engine, or of the expedients by which either may be minutely improved. We have no tests of high duty pumping engines, nothing of any type of marine engine, and but the slightest touch of the locomotive. And yet these things have lost nothing in actual importance or in extent of employment, but relatively to the whole they have not held their own. Many other interests have arisen and have been added to the mass to be considered, and some perhaps by novelty have crowded to the front beyond their equitable rights. The steam boiler is perhaps the only thing that is still both relatively and actually as great as it ever was, because that is the one thing which is associated with every other, and is not as yet likely to be superseded. It grows side by side with all the others. Mechanical engineering is all in the application of power, and whatever means may be adopted for power transmission and application the bulk of the power, and an increasing bulk of it, must come from the steam boiler. Niagara and all the water powers are second, and must always be second, to the steam boiler in mechanical engineering. The tall office building (with the tall industrial building also crowding for recognition) is coming to be regarded as one of the great achievements of modern mechanical engineering, which it is almost as completely as is the steamship, if, indeed, in the extent of employment for its construction and operation, it does not soon vastly exceed the steamship interest, and we accordingly see it claiming recognition in the transactions of the engineering societies. Originally an outgrowth of the elevator, the elevator is now one element only, although perhaps the most important, of the building. The building throughout is now a construction of steel, with stone and brick as incidental attachments, and not of crude steel simply piled up, but of steel carefully machined, accurately fitted and securely knitted into an organic and interdependent structure. The sinking of the foundations, the entire construction and erection of the building, and its operation thereafter, are all mechanical engineering work, and the permanent engineering equipment for the elevators, the lights, the pumps, the ventilation, the fire service, the supply of incidental power wherever required throughout the building, constitute problems as important and as exacting as the engineer can wish to encounter. It is no coming down of the society for it to give prominence to these things, for these constitute the leading work of the mechanical engineer at this moment.

American Locomotives in England.

Our British contemporaries continue to discuss an "invasion" with locomotives, etc., and various explanations are offered for it.

A contributor to "Engineering" referred to the Prince Albert and silk-hat-attired superintendents who repel anything in the way of suggestions from employees as one cause of it, and this is commented upon by another contributor as follows:

"I must say that although I am an English engineer (with considerable experience in America) I cannot help agreeing with him in most of his remarks, chiefly those with reference to the 'Prince Albert' and 'Plug' hat superintendent, and the superiority he assumes over his less fortunate colleagues, the fitter and mechanic. We must all admit that the fitter and mechanic is essentially a man in a position to see improvements and get ideas as he proceeds with his various jobs, but in this country he is ground down to a low level and knows well that if he attempts to suggest or put forward his notions he is snubbed for it, while at some future time that idea is brought forward more or less imperfectly by his superiors.

"In American shops every man is supposed to be blessed with a certain amount of brains and to be something more than a mere machine, and it is from him that the majority of improvements come. He gets an idea, talks it over with his superintendent, he is encouraged, and the thing becomes a success.

"Of course, the chiefs of each branch in most of the large American works are 'Americanized Britishers,' but they work together, and not at cross purposes, as is the case in most of our works.

"If every workman and draftsman in this country got the credit for what he did instead of only being blamed for slips which are to all of us inevitable, and not wholly due to carelessness, there would exist a better feeling between master and man, and employers would be in a better position to compete with American firms."

While there is in this a point that might profitably be considered by some British shop owners and superintendents, there is

also a lesson in it for some of our American shop managers as well. It is by no means the fact that in all American shops the men receive the encouragement they should in this matter, and it is certain that in many American shops to-day the men carefully refrain from making any suggestions whatever in reference to their work, because experience has shown them that such suggestions are either not decently received or that the ideas are simply stolen by narrow-minded and jealous foremen or superintendents, and all credit appropriated by the thief.

One or two such experiences by one or two of the men are sufficient to stop all such efforts and put all the men into an attitude of mind that is fatal to any advance whatever except that which is forced upon them from above, and such a shop is seriously handicapped.

To the extent that this attitude of mind or division into rigid classes contributes to our industrial superiority, it may be counted upon as practically permanent, for these things cannot be changed in a day or in a generation, even when there is a real effort to change them.

There are some indications that, taking the country over, we have of late years deteriorated in this respect of freedom of intercourse between workmen and their shop superiors, and it is quite certain that just here is one of the points whereon the small shop is likely to have an advantage over the larger one.

The shop potentate who treats even a worthless suggestion with contempt or derision, as too many of them do, is making a serious mistake and effectually barring the way of an important aid to shop progress.

New Combinations.

Among the newest of the trusts that are projected are two that specially interest machinists. One aims to control the file business, the other leather belting.

It is announced that traveling and resident salesmen are to be asked to join an organization, the object of which is to resist reductions of salaries made by the combinations, and take action to prevent such combinations so far as possible. "The economies that can be effected by the elimination of competition" of course bear with special severity upon salesmen, who are one of the important agencies for conducting competitive business; hence, this new trade union.

It is given out also that the newly organized, or to be organized, safe trust will set aside a fund to be used in the erection of a plate mill, in case the steel combination should undertake to charge too much for steel plate to be used in safe making; and thus we see that while it is all right for a given industry to organize to control prices of its product it is wrong for another industry to organize for the same purpose, if its operations are going to interfere with the money-making operations of other organizers.

It seems to us that the various organizations had better get together at once and agree upon a plan of co-operation, for it is evident that if each trust or combination is to be mulcted by every other one with which it must do business they will all be going around a circle, so to speak, and in the end the only ones that will prosper will be those that "have their feet upon the ground, like the Standard Oil, coal, iron ore, railroad, telegraph, street railways, etc.

"The Engineer," of London, in discussing the American locomotive's invasion of England, says: "It is of course to be regretted that English gold should go to pay American workmen, and we are not at all surprised to find that the railway companies and locomotive builders are alike censured for want of patriotism."

We will engage to give two pounds sterling for every one pound of "British gold" that finds its way into the pocket of an American workman on account of these orders for locomotives, and we do not believe that any "British gold" will be sent here on account of them. These locomotives will simply help to pay the interest bill and the rent bill and the dividends to British holders of American bonds, lands and shares of stock; which payments would otherwise have to be made in American grain or other agricultural products. If our amiable contemporary cannot do better than this when alluding to economic matters, it had better confine itself to the Spanish-American war, a subject on which it has been strangely silent of late.

A recent test of a steam fire engine in connection with the stand pipe of one of the tall office buildings of this city showed that there is no lack of power in the engine, and that water may be delivered in powerful streams above the highest points of the highest buildings by the power of the steam in a fire engine of the ordinary type. The building at which the trial was made was that of the Manhattan Life Insurance Company, the roof of which is 250 feet above the street, while the gallery of the dome is 340 feet high. Ten feet above this gallery is the base of a 30-foot flagstaff. An engine standing in the street was connected to the lower end of the stand pipe, and with a 1⅜-inch nozzle a stream was thrown about 70 feet above the top of the flagstaff, or 450 feet above the street. The pressure at the nozzle was 50 pounds, and at the engine it was 290 pounds.

Not Blusterers.

"Don't swear, boys; shoot." Col. Wood to Rough Riders.

"You may fire when ready, Gridley." Words of Admiral Dewey, opening the naval battle at Manilla.

Commercial Review.

NEW YORK, SATURDAY EVENING, April 22, 1899.

MACHINISTS' SUPPLIES.

The month of March was probably the month of heaviest sales by the supply trade in New York that has been known in many years, if not in all time. Various houses report it the best month in their respective histories. Between March and April it is a close contest, but one derives the impression that trade attained its maximum in the earlier month, and that while business is still very active, it is becoming a little easier than it was. This opinion is put forward with hesitation, for many houses detect no falling off, and these include some of the most representative.

Twist drills are holding steadily at the prices prevalent for the past few months. The advance last November did not apply to export trade, and consequently sales are being made for foreign account lower than for domestic.

Some of the file manufacturers announce an advance of 5 per cent. The Kearney & Foot Company raised its prices that amount about three weeks ago, and the Arcade files have been stiffened up in about the same degree. The advances do not appear to be due to anything in the nature of a "combine," nor to be true of all makes.

George T. Montgomery, of the machinists' supply firm of Montgomery & Co., New York, has returned from a brief European trip. His time was spent chiefly in Paris. He states that business there appeared to be active, a manifest improvement having taken place since he was abroad last summer. He finds upon his return to this country that the March business of his firm was the largest for any month in its history, and as nearly as can be judged, there is no falling off in April.

The Frasse Company will remove, May 1, from 17 Warren street to 38 Cortlandt street.

The L. S. Starrett Company has been working till 9 o'clock at night striving to catch up with orders. Judging from their New York trade, this month shows no relaxation after last.

The Law Company, which in addition to emery wheels and other goods, has been handling since the first of the year the Reed Manufacturing Company's sectional jaw pipe vise and adjustable pipe wrench, reports that the latter company is at present 1,500 vises behind with orders, and owing to the demand has made a 5 per cent. advance in prices all around in the last ten days.

THE CUBAN OUTLOOK.

To those who, at the close of hostilities with Spain, expected a speedy awakening to industrial activity in Cuba, the situation is distinctly unsatisfactory. One of the

best-known ante-bellum machinery and supply exporters to Cuba, who a few months ago was quite gratified at the way that trade seemed to be opening up, now admits his disappointment. Some houses, however, which do not make as much of a specialty of the Cuban market, express themselves as pleased with the orders they have received. A file company, for instance, which sent a man down there some time ago, is getting about one order a week, and a twist drill company is receiving orders with about the same frequency, or infrequency. A manufacturer of twist drills, wrenches, agricultural goods, etc., reports that Cuban trade has been pretty good, but that it has fallen off a little latterly. Another house has lately made a sale of fifteen or eighteen rolls of belting for use on the island. And so it goes.

We have just had an interesting conversation with a man who has returned from traveling all through Cuba to sell machinery and miscellaneous supplies. He secured a pretty fair volume of orders, fully paying his expenses, yet is very pessimistic regarding business conditions upon the island. Industrial expansion is handicapped by the political instability. The insurgents have taken to the hills as bandits. On sugar plantations work is being done only eight or nine hours a day, instead of twenty-two or twenty-three. They are fortified with block houses, and armed guards are stationed to protect the workmen. A train of excursionists from the steamship "Paris" was held up on the second day out. The traveling salesman must carry a gun on his back wherever he goes, and he must use it once in a while, too. Notwithstanding the talk about the necessity of capital to develop the island, there is plenty of native capital down there awaiting investment, chiefly in Spanish hands. Of the American capital that is flowing there so eagerly, some will probably be wasted, while some of it may be made to pay by investment in enterprises such as electric roads, which the natives themselves are indisposed to promote. Assuming the most favorable conditions it appears that two years must elapse before the demand for machinery and supplies for the sugar plantations can become really active.

STEAM PUMPS FOR EXPORT.

The Henry R. Worthington Hydraulic Works have many foreign orders on hand and are shipping heavily to their London branch. Their European shipments are said to be averaging more than two carloads of pumps a week. An outfit of Worthington pumping machinery has been ordered for furnishing the water supply of the coming Paris Exposition. The plant will comprise four Worthington horizontal, high-duty, triple-expansion, condensing, pumping engines, having a total capacity of 44,000,000 gallons in twenty-four hours, which will be constructed in France. Some smaller machinery will be sent from this country.

Much business in marine pumps for foreign account is said to be in progress with the George F. Blake Manufacturing Company. Shipments of such pumps have recently been made to the Vulcan Works, Stettin, Germany, to equip Japanese and Russian war vessels being built there. This company will have ready to ship shortly fifty large marine pumps for both the North German Lloyd and the Hamburg-American steamship companies. The French orders aggregate some forty pumps, some of which are to be used on the new liners of the Compagnie Generale Transatlantique now building at Havre. The company have orders on their books for the Austrian navy, and they are at present negotiating with the Russian Government for considerable machinery in the pumping line.

POWER TRANSMITTING MACHINERY.

When the rain has been falling into a bucket until it is full and overflowing you cannot say that the receptacle is filling up either more or less rapidly than before. That is precisely the condition of the two most representative power transmitting machinery houses in town. The other dealers in this class of material, from whom reports have been received, are also busy. It must be admitted, however, that a prominent wood pulley house, which received for the month of March the best volume of business in its experience and was highly favored during the early part of the present month, has felt an easing up of orders for the last three or four days.

Some of the power transmitting machinery companies have advanced prices at the beginning of this month, or subsequently, though one of the largest still quotes old prices. A certain company which has made an increase states it to be from 10 to 20 per cent., referring to metal goods. While it is not generally admitted that wood pulleys are on the advance, a company making a specialty of that line gives information that they are figuring upon a 10 per cent. raise, and trying to put the same into effect as far as feasible, and the assertion is made that their competitors are quietly doing the same. One of the more important Dodge patents will expire July 4, and there is some speculation as to its effect upon the market. There are now in the field only two or three wood pulley makers of prominence other than the Dodge Manufacturing Company, and it is possible that some new ones may be started; yet the parties now in the business are reluctant to admit this.

The Dodge Manufacturing Company has received from the New York Mill Company, near Utica, a contract for a cotton mill equipment to be shipped to the South. The George V. Cresson Company, Philadelphia, is building a large rope drive for the Trenton Iron Works.

JOTTINGS THROUGH THE WEST.

The West is one tale of industrial activity. Prosperity has assumed a tone of blank sameness. In engines, machine tools (big and little) and machinery of almost all other kinds manufacturers have all the work they can do, and more of it than they can do. It is a common experience to be five months behindhand with orders. Dealers—notably in Chicago and Pittsburgh—complain that they have to hold orders on their books till manufacturers can fill them. There is a general howl over the scarcity of raw material. Some are bewailing the fact that their patterns are allowed to lie in the foundry for five or ten weeks before they can get the castings.

For electric motors and for gas engines there is no limit to the demand, all sizes being in requisition, from the smallest upward. Manufacturers of tools are willingly acting upon the idea of building their machines so that they may be, if desired, directly geared to motors. The Bullock and Keystone electric companies are building motors with especial reference to direct connection to tools, and are finding considerable encouragement in doing so. It may be mentioned, by the way, that the General Electric and Westinghouse companies are entering more largely than formerly into the small motor business. The three big bays of the shops of the Westinghouse Electric & Manufacturing Company's works, at East Pittsburgh, running parallel to the railroad track, are being extended in a westerly direction. The addition is to be equipped by the company with the most modern tools obtainable.

The Buckeye Engine Company has enough orders on hand to keep its works busy for the rest of the year, unless the plant should be enlarged. The company, indeed, has an extension under consideration and holds the land for the purpose.

Engine builders in some cases are quoting prices for one day only. A certain company recently offered an engine for $10,000. Two days later the quotation was raised to $11,000, and at the end of five days the contract was received at $11,500.

The present boom in machinery in the West has proved a blessing to the second-hand dealers, who have had an opportunity to market their stocks.

A. L. Ide & Sons, Springfield, Ill., send a list of recent orders and shipments of their engines, among which the following may be mentioned as the most interesting: Monterey Electric Light Company, Monterey, Mex., one 250 horse-power and one 110 horse-power tandem compound engine, belted; Emery, Bird, Thayer Dry Goods Company, Kansas City, Mo., one 260 horse-power, direct connected; Kingman Plow Company, Peoria, Ill., one 100 horse-power, belted; Caro Light & Power Company, Caro, Mich., one 300 horse-power, belted; F. W. Horne, Yokohama, Japan, one 40 horse-power, direct connected;

Deadwood & Delaware Smelting Company, Deadwood, S. Dak., one 100 horse-power, direct connected; Hillman Building, Chicago, one 125 horse-power and one 150 horse-power tandem compound engine, direct connected; Illinois State Reformatory, Pontiac, Ill., one 200 horse-power, belted; Lancaster Electric Light Company, Lancaster, Wis., one 13x12-inch, belted; Chicago & Great Western Railroad Company, for shops at Oelwein, Iowa., one 180 horse-power and one 300 horse-power; Empire Zinc Company, Joplin, Mo., one 150 horse-power and one 100 horse-power, direct connected; Mississippi River Commission, two 500 horse-power tandem compound engines.

CHICAGO MACHINERY MARKET.

One of the significant facts of the local machinery market is the large number of small machine shops that are springing up. Allusion was made to this some weeks ago, but the growth has since become more marked. Where a few months ago many vacant rooms suitable for light manufacturing could be found on Canal and adjoining streets, now a desirable location for a modest machine shop is very scarce. Owners of small plants who were willing to sell out a few months ago are now a contented class of people. They have all the business they can do. Makers of dies and special tools and workers in various kinds of metal industry have invaded the precincts of the machinery district to the point of repletion. They are receiving the overflow trade. This is an incident, rather than an important happening in the machinery market. The machinists' tools and supplies that are sold to these new concerns are a small item, comparatively speaking.

Buying of machinists' supplies has been very active during the past few weeks. On the whole, there seems to be a decrease in comparison with the March trade, which with very many sellers was the largest in their history. But the decrease will be slight, and as compared with April, 1898, sales this month will show a decided increase. Every week there are buyers in the market for tools and supplies with which to equip large additions to factories. The expansion of the large manufactories progresses at a pace as swift as ever. Western bridge works are enlarging and buying lavishly to take care of an enormous trade. Car works are pressed to find every facility for an increased production. One local electrical plant has bought machinery to the value of $50,000 during the past few weeks.

The large manufactories, which buy their supplies by annual contracts, are now in the midst of that procedure. On account of the advance in prices, some of them are anticipating their needs a little, and are asking for a renewal of contracts, which do not expire before June 1. For various kinds of supplies deliveries are becoming quite lame. Some manufacturers of chucks cannot fill orders for two months or more, and the situation is growing steadily worse. For drills and files there is also a difficulty in obtaining prompt shipment from factory.

By way of contrast to this very satisfactory condition of things, some factors in the trade note a tendency to hesitancy in new business. The extreme difficulty in procuring material in many lines of iron and steel product is delaying shop work noticeably. A few manufacturers, usually small ones, who accepted contracts some months ago and kept on buying material from day to day without covering their contracts are now quite diffident about rushing their engagements through to completion, since they cannot now get out even with an advance of 50 per cent. in the cost of material. And so rapid has been the rise in cost of material that a modicum of new business has been temporarily shelved. But these are minor notes. The obtrusive fact is that there is more business in sight than makers and traders can comfortably transact.

Quotations.

NEW YORK, Monday, April 24.

Iron—American pig, tidewater delivery:—

Pennsylvania irons:	
No. 1 X foundry	$16 75 @ 17 00
No. 2 X foundry	15 75 @ 16 00
No. 2 plain	15 25 @ 15 50
Gray forge	14 75 @ 15 00
Alabama irons:	
No. 1 foundry	16 00 @ 16 50
No. 2 foundry	15 25 @ 15 75
No. 3 foundry	14 75 @ 15 25
No. 1 soft	16 00 @ 16 50
No. 2 soft	15 25 @ 15 75
Foundry forge	14 25 @ 14 75

Bar Iron—Base—Mill price, in carloads, on dock: Common, 1.50 @ 1.55c., nominally; refined, 1.58c., upward. Store prices: Common, 1.70 @ 1.75c.; refined, 1.75c., upward.

Tool Steel — Base Sizes — Standard quality, 6 @ 7c.; extra grades, 12 @ 14c.; special grades, 16c. and upward.

Machinery Steel — Ordinary brands, from store, in small lots, 1.95 @ 2.00c.

Cold Rolled Steel Shafting—Base Sizes, from store, in small lots, 2.75c.

Copper—Carload lots, Lake Superior ingot, 19 @ 19½c.; electrolytic, 17¾ @ 18c.; casting copper, 17½ @ 17¾c.

Pig Lead — Carload lots, 4.32½ @ 4.35c., f. o. b. New York.

Pig Tin—For 5 and 10 ton lots, 25¼c., f. o. b. New York.

Spelter — In carload lots, 6¾c., New York delivery.

Antimony—In cask lots and over, 10 @ 11c., according to brand and quantity.

Lard Oil—Prime City, present make, 44 @ 46c., for the leading brand, in wholesale lots.

Some Amateurs' Machine Tools Made in England.

On going into a famous restaurant in Manchester, England, with an engineering friend of mine, he introduced me to Mr. Birch, of the firm of G. Birch & Co., Islington Tool Works, Salford, Manchester. I found Mr. Birch to be very well acquainted with the "American Machinist," thoroughly well informed about American machine-shop practice, and also much interested in what we here in this country are doing in the line of machine construction. He gave me a very cordial invitation to visit his shop, and at the first opportunity I accepted, and found him engaged in a class of work of which we here in America know comparatively little. He builds machine tools (mostly lathes) for use by amateur mechanics. In England many college professors, lawyers and "gentlemen" spend a portion of their leisure time in making mechanical objects, especially in doing ornamental turning in wood, ivory, etc., and many of the things made by them are highly ornate. They are treasured as examples of the makers' skill or distributed to more or less appreciative friends. In that country the business of supplying the needs of this class of mechanics is a very considerable one, though it is practically unknown here, our professional men and gentlemen who find leisure on their hands being generally disposed to spend it in some entirely different and often less commendable way.

Some of the tools made by Mr. Birch will probably be of interest to "American Machinist" readers, and a description of a few of them is accordingly given. Fig. 1. for instance, is what Mr. Birch calls his "pate + 5½-inch center, ornamental and screw-cutting lathe." This means, of course, that it has 11 inches swing, and, as will readily be perceived, it conforms in its main features to the familiar and regular English type of lathe, but has very many extra features and supplementary attachments, the uses of which it would take a novice some little time to learn; and with this lathe the regular machinist would at first be almost as much of a novice as anyone else would be.

In the first place, the lathe has two spindles—although this feature does not show very clearly in the engraving—there being a supplementary spindle behind the main one and parallel to it. This supplementary spindle is used in turning medallions, etc.; and a slow speed being necessary for this purpose, the spindles are driven by means of the cone pulley seen below at the left-hand end of the machine, and the intermediate pulley at the rear of it. A belt leads from this to the supplementary spindle which drives the main spindle by change gears, so that the relative speed of the two may be anything desired.

Various kinds of chucks are provided having slides with micrometer screws and fitted also with indexing devices, so that

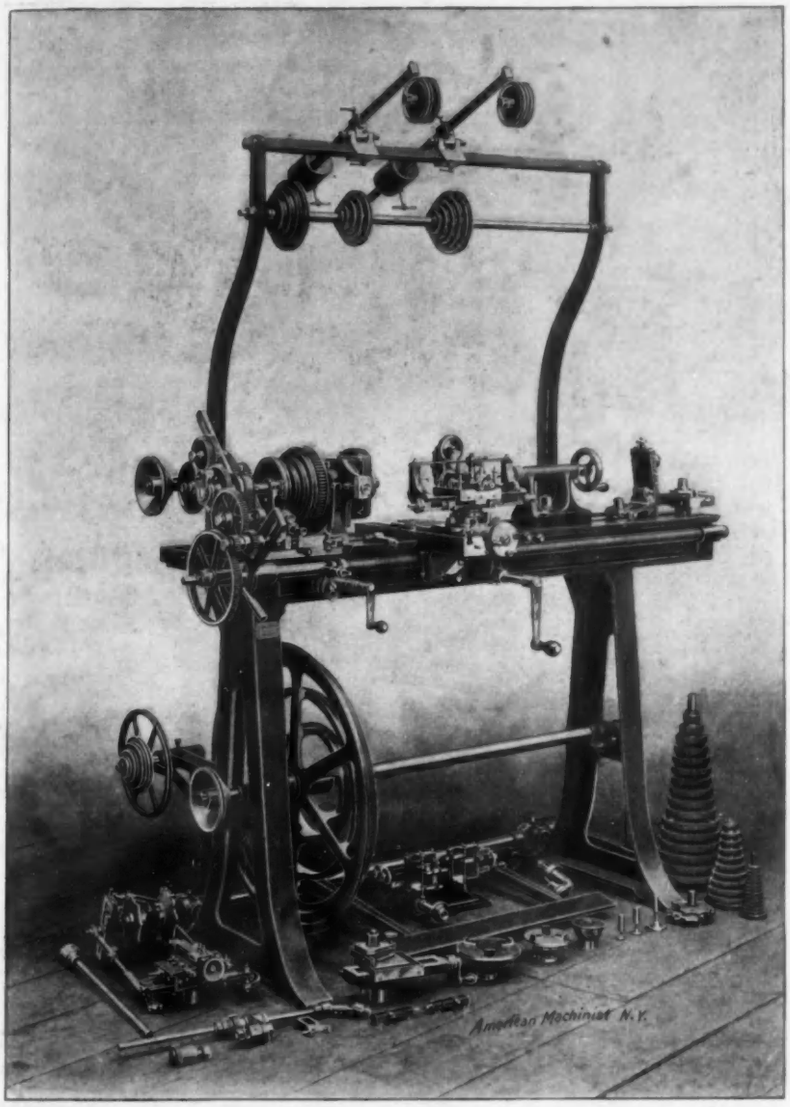


FIG. 1. 11-INCH SWING ORNAMENTAL AND SCREW-CUTTING LATHE. G. BIRCH & CO., MANCHESTER.

work held and mounted on these chucks may be operated upon in any desired manner and to produce a very wide variation in character of work. One such chuck is shown in position upon the main spindle in Fig. 1, it having a nose to which the regular lathe chuck or face plate can be screwed the same as to the spindle itself. Then the work can be given any desired degree of eccentricity and may be indexed to various positions. This chuck is used for turning oval forms.

The carriage is very similar to the ones usually provided with English lathes, but in this case, in place of the ordinary tool-rest, is one designed to cut spirals by a vertical cutting spindle driven by means of the small grooved pulley (seen at the top of the rest) and bevel gears. This vertical spindle, by means of the bolt and circular slot seen in front, can be set at any required angle, and may be made to recede from or approach the work to give any desired form as determined by a guide-plate or templat shown at the top of the attachment. This attachment can also, of course, be set at any desired angle, and a nut on its cylindrical shank enables it to be accurately adjusted for hight. Other attachments are seen on the floor; the one directly under the lathe being for the purpose of turning medallions such as that shown in Fig. 4, which was given to me by Mr. Birch, and is a piece of ebony having on it a figure which was copied from a copper electrotype of the original medallion. In this process the original or piece to be copied—in this case the electrotype—is mounted upon one of the spindles, while the work to be operated upon is mounted on the other spindle. The attachment referred to has what may be called a tracer, which, as the original revolves, rests upon its surface, and is thus made to move to and from the headstock; which motion, by suitable levers, imparts a similar motion to the cutting tool supported in the same fixture and opposite the work. Thus the original is reproduced, and this may be done to any desired scale, larger or smaller. On the piece of work shown by Fig. 4 it is possible, with a magnifying glass, to observe the point at which the cutting tool began (or ended) operations, which point is located about ⅛ inch below the ear. From this point the marks of the cutting tool extend in concentric rings that show the rate of feed to have been about .01 inch, and the reproduction is accurate.

Other attachments seen about the lathe are used for various purposes in producing ornamental work, and all the traversing screws are supplied with micrometer graduations. This applies also to the movement of the carriage by the lead-screw, which may be done by hand by means of the crank-handle seen at the left, which is placed on either one of the two squared shafts shown, one of which turns the lead-screw by bevel gears, and the other by worm gearing; the pinion and the worm being mounted in a swing plate which

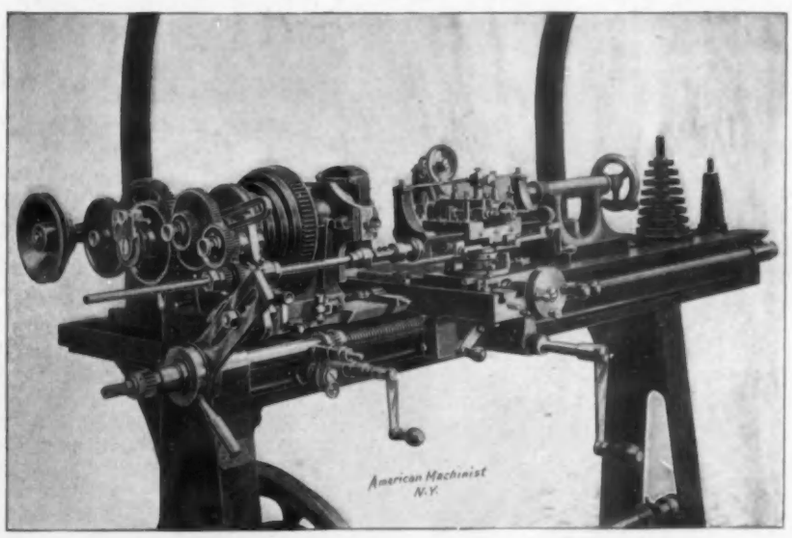


FIG. 2. BIRCH'S ORNAMENTAL AND SCREW-CUTTING LATHE, ARRANGED FOR CUTTING SPIRALS.

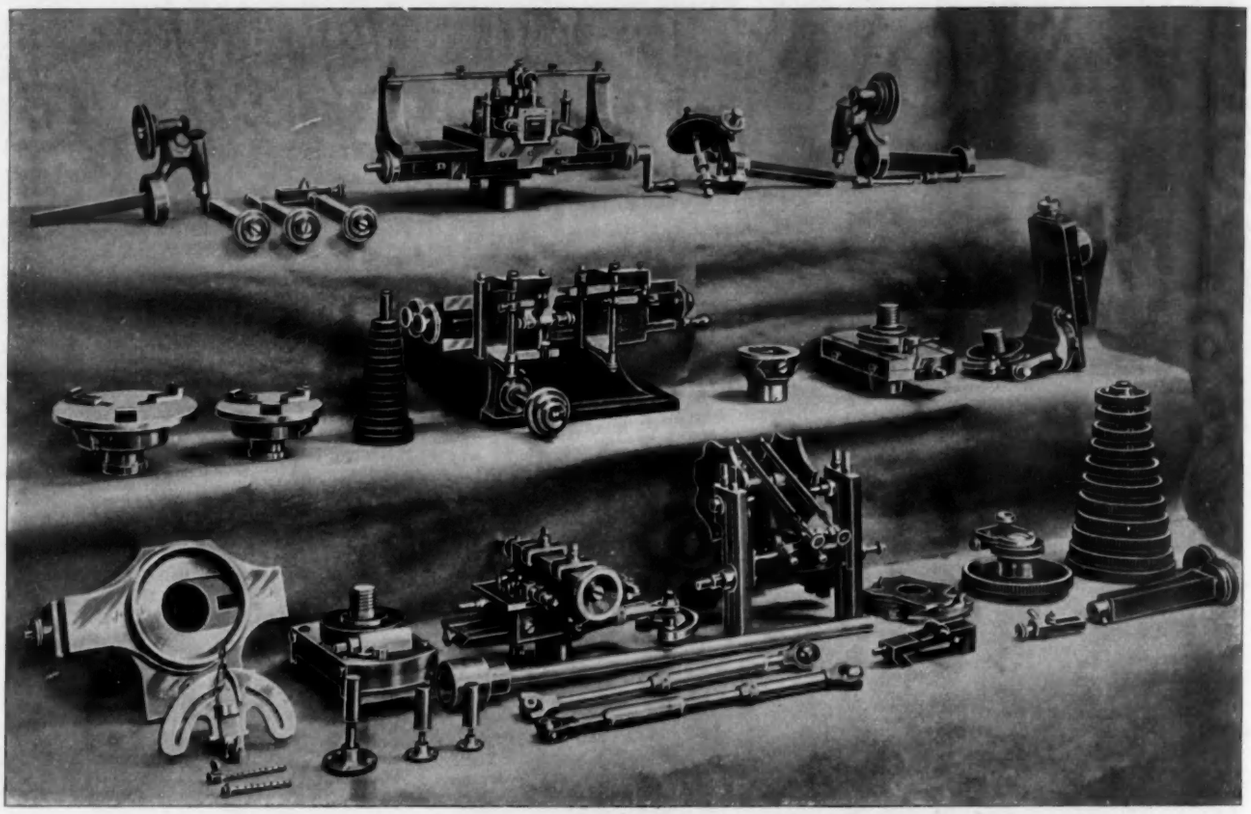


FIG. 3. APPLIANCES FOR ORNAMENTAL TURNING. G. BIRCH & CO., MANCHESTER.

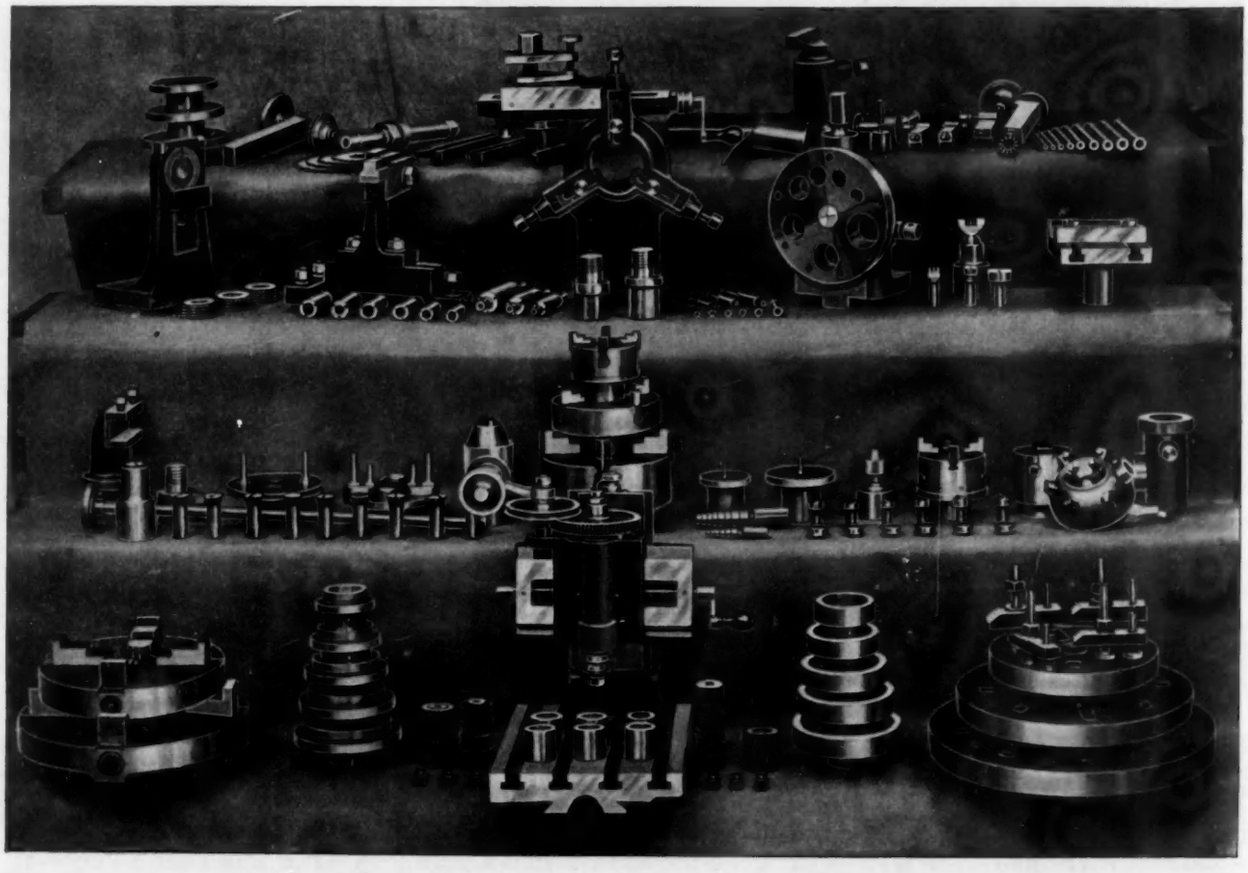


FIG. 5. APPLIANCES FOR METAL TURNING. MADE BY BIRCH & CO., MANCHESTER.

FIG. 4. A PIECE OF MEDALLION TURNING IN EBONY MADE ON A BIRCH LATHE.

shifts to bring either one of them into or out of engagement.

The lathe has the "overhead" referred to recently in these columns, and in this case it is double, so that two different fixtures may be given motion at the same time if it is desired to do so, and the use of the counterbalanced belt-tighteners will be readily understood.

At Fig. 2 is a larger view of the same lathe with the same attachment on the carriage, but arranged to give motion to the lead-screw of the rest, as shown.

At Fig. 3 are shown various attachments for ornamental turning, description of which would require too much space; but the use of the various devices may be readily perceived in most cases. The larger attachment near the center is the one for reproducing medallions, and the one just above it is the one shown on the lathe in Fig. 1.

At Fig. 5 are the attachments for metal-turning, the uses of which will be readily understood, and at Fig. 6 is a less elaborate lathe arranged to be driven either by power or by foot treadle, and having a set of gears with worm wheel for indexing.

This lathe has tumbler gears for reversing the motion of the lead-screw, as is the usual practice here, but is not common in English lathes, and there is no automatic feed except by the lead-screw—a feature which would not be considered satisfactory here. The chain connection for the pedal crank is quite common in England, and is, I believe, there considered to be better than a pitman. It cannot force the pedal down upon one's foot or so as to break anything, and running over a pulley below, which turns freely, it probably works with very little loss of power by friction. Under the lathe in this case is the gear-cutting attachment, which goes on to the cross-slide in place of the compound rest. Both lathes are, I believe, excellently well made, and have hardened and ground spindles running in hardened and ground boxes.

At Fig. 7 is a lathe that is very much like the Ballou lathe, at one time made in Hartford. It has been changed somewhat, however, notably in the style of the tool-post, and in the form given to some of the crank handles. An automatic cross-feed has been added by means of the shaft, with universal joints seen on the carriage. There is an index plate in front and by the worm wheel at the rear of the cone-pulley, and the carriage may be moved by hand by means of the worm gearing at the end of the lead-screw. This lathe has the familiar side-saddle arrangement with vertical slide which is available for any fixture that may be attached to it. This, like the other lathes, has also a withdrawing attachment for screw-cutting, which is apparently much more favorably regarded on the other side than here, and which is certainly a very great convenience in many cases—at least where, as in this case, it is well made and so arranged as to cause no bother.

At Fig. 8 is shown a milling machine made by Mr. Birch and adapted to be driven by foot power, the other features of the machine being for the most part quite familiar. Although the centers can be set at any desired angle, apparently the machine is not universal, and is not, I believe, adapted for cutting spirals.

Some larger tools are also made by this company, among them being a gear-cutting machine similar to those made by the Pratt & Whitney Company, and capable of cutting up to 6 feet diameter. There are also some universal milling machines, made to be driven by power, but I believe the principal business of the establishment is in this line of machine tools for amateurs' use.

While in this shop I met a type of the

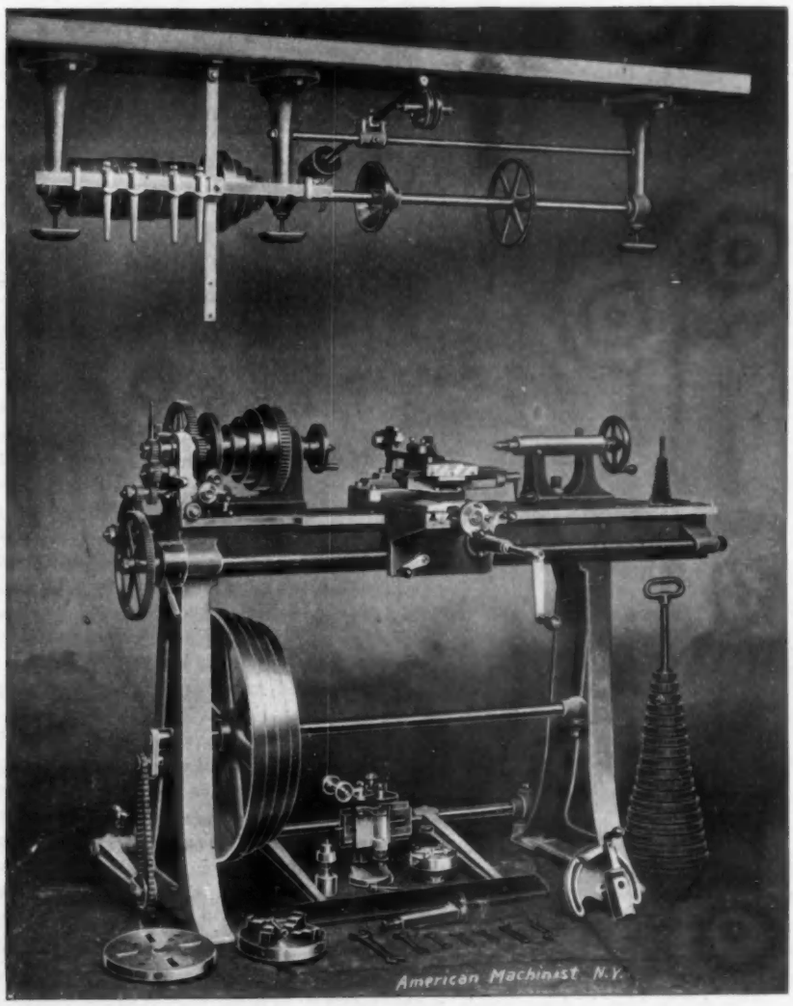


FIG. 6. 12-INCH SWING "SLIDING AND SCREW-CUTTING" LATHE FOR TREADLE OR POWER.

English amateur mechanic, who was primarily a horseman; that is to say, he was interested in good horses, but was also interested in mechanical matters, and was having a fine lathe built in the Birch shop. On that day he had come in there from his distant residence, by appointment, to inspect the lathe as it approached completion, to test it and to see that it had been made to meet his requirements in all particulars. Two or more men who had been at work erecting it were discussing its various points with him and going through the tests, putting in, I should say, considerably more time at this than the average builder of small lathes in this country would devote to the entire process of adjusting and testing. The incident illustrates perhaps the very striking difference between the methods pursued in the two countries. That is to say, here if a man wanted a fine lathe of this character he would probably buy it from stock, with the assurance that it would be all right and satisfactory. This amateur mechanic was, by the way, a genial, whole-souled, good fellow. I discussed various things with him, and remember his saying that at the time he was riding a Columbia wheel; that he had tried pretty nearly if not all the best English machines, and had taken them apart to carefully inspect them. He said he thought the Columbia was decidedly superior to them all, and was much more accurately built. F. J. M.

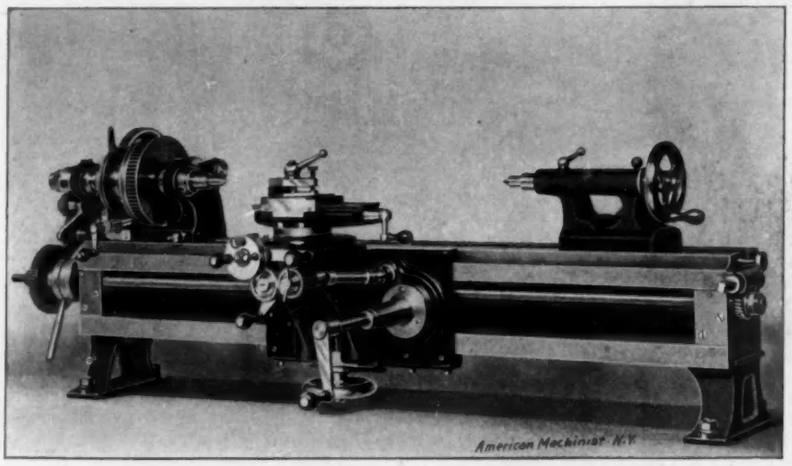


FIG. 7. 8-INCH SWING FRONT SLIDE BENCH LATHE. G. BIRCH & CO., MANCHESTER.

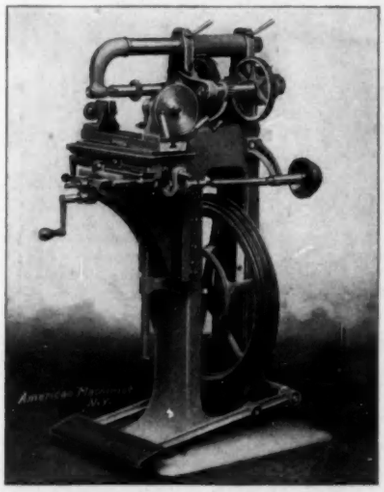


FIG. 8. MILLING MACHINE WITH TREADLE MOTION. G. BIRCH & CO.

Machine Tools—I.

BY J. RICHARDS.

GENERAL REMARKS.

The writer, who himself has spent the greater portion of his life—thirty years or more—in making machine tools for metal and wood, feels that he has earned in some degree the privilege of looking back, reviewing and criticising the practice—his own included.

It is a misfortune that in all branches of skilled industry experience and the scope of observation are inversely as the use that can be made of these things after their acquirement. It is seldom that anyone not marvellously gifted becomes a competent designer and skilled constructor of machinery before the middle point of active life—oftener beyond that—and his useful work thereafter must be confined to looking back and pointing out the errors and mistakes that his own experience has included.

This is not an agreeable task, and is commonly a thankless one. There is a natural repugnance to having one's mistakes pointed out, and an aversion to criticism, even when impartial; not always, to be sure, but in most cases. This is especially true in the art of machine tool making, because it is a branch of machine construction resting more than any other upon personal knowledge, gained empirically and without those potent aids of a scientific nature that nowadays shorten years into months, in the course of evolution.

The best skill and the best implements are in all countries devoted to the making of machine tools. It is an art *sui generis*, in that these implements are self-creative, reproduce themselves, so to speak—a singular distinction when we come to think of it—one without a parallel, indeed, in the whole range of industrial implements.

These circumstances point, inferentially at least, to an art moving along under fixed standards, uniform practice, and analogy of design—to settled coefficients for strains, dimensions and proportions. But, strange to say, we find that in machine tool making there is a paucity of these resources so successfully applied in making steam, hydraulic, textile and other machinery. The Diesel motor, for example, has gone further toward a final type in twelve months than the engine lathe has in half a century. The multifarious devices and apparatus involved in the electrical arts have in ten years come much nearer a standard construction than can be claimed for either of the leading implements in metal working, the lathe, planing and drilling machines.

There is a reason for all things, if we but have the cunning to find it out; but it will baffle anyone to search out a sufficient cause for the diverse practice and absence of standards in machine tool making. "We have no use for the *x-y-z* fellows," said a machine tool maker to the writer, and it will be hard to present the fact in a way more forcible than this remark suggests. The university students, and even the graduates of technical training schools, shun the machine-tool works, or rather they do not think it worth while to apply there, well knowing that the methods and the training they have acquired are considered of slight value where but little is computed, strains are not measured or their value known, where things are "contrived" by skilled men proceeding mainly by intuition and the light of previous experience.

This fact came plainly to mind recently when the writer was discussing with a friend the methods of making guiding ways for lathe carriages, here and in England—angular ways and the flat or gib systems they are called. A college student who was present asked, "What is the difference between the two methods?" Here was a "settler," so to speak. Who was to inform him of the difference? It is not written up in books, is not demonstrated by collated facts or otherwise. No tool maker has analyzed this difference or the reason why one or the other of these systems is better or worse than the other. The whole subject is chaotic—rests on opinions and often on prejudice. The young man said he would "try to find out," and most likely will do so; but there is really no demand for his information

when it is acquired, no matter how exact it may be. This subject of the guiding ways will be considered in a future place.

Some years ago, about 1880, there was instituted at the John Hartman Works in Chemnitz, Saxony, experiments to determine some rules respecting performance, strains and so on in operating machine tools. These experiments, so far as made, seem to have been for the benefit of the Hartman Works alone, and were not given out to the public, as is the custom in other kinds of work—a thing not to be wondered at when we consider that tool makers, except as a means of selling their product, do not, as a rule, give publicity to their improvements. There is, no doubt, a considerable application of scientific methods to this industry in Germany. The business began there under many adverse conditions thirty years ago, at first not very successfully, but a fair inference is that both in design and workmanship the center of this art in Europe may, in the near future, shift from England to Germany. There may not be at this time facts to support such a prediction. It is based on the relative advance made during the past ten years.

The most notable and rapid advance in machine-tool practice that its history affords has taken place in this country during ten years past. This period is named, because from an extreme diversity that had preceded, there has been a wonderful advance toward uniformity in design and quality. Formerly, and for thirty years past, there were a few firms who strove after excellence in their work, kept informed respecting practice abroad and employed skilled people to prepare designs, but the number of such firms could be counted on the fingers of one hand.

In other works, the business was a "manufacture," wonderfully good as such, but incapable of meeting the requirements for special implements, and in the matter of quality was below the standard demanded by an increasing foreign trade in American machine tools. For this reason, and others that might be named, there was a sudden advance all along the line, so to speak, and the standard of machine tools rose within a few years to a position alongside that of certain special implements in which American makers had long before attained a leading place.

This advance in American practice has been in all essential features—in strength, accuracy, adaptation and design, the latter coming latest, and yet with much to add. By design is meant the contour and "appearance" of framing, and its disposition in respect to the lines of strain, which fortunately always harmonizes with symmetrical appearance.

A potent influence in this change has been the greater demand for machine tools that has enabled organized manufacture by division of the work. The manufacturing plan, to which all industries in this country tend, is permitted by makers confining their energies and skill to implements of one kind, and in some cases to a few sizes of that kind. This is the main cause that enables competition with European makers in the neutral markets of the world.

Two of the components of production, material [Mr. Richards must base his statement regarding cost of material on prices prevailing on the Pacific coast.—Ed.] and expense, cost more in this country, but this is fully compensated by specially skilled labor, attained by organized manufacture and otherwise.

When workmen received four dollars a day in Waltham and four francs a day in Geneva, the American and Swiss watches met in London, and the Americans won the field for all watches that come within the "manufacture" grade, which grade was necessarily a high one. It is much the same with machine tools. In this country the "rate" of wages is high, but the "amount" of wages is low, by reason of a phenomenal production due to ingenuity, skill, special implements and processes.

The export trade in machine tools will be permanent, and must increase, unless affected by fluctuations in the cost of production. This nearly ruined an export trade that had fairly begun in 1877-78, but is not likely to occur again, in the same degree at least.

In the special and smaller class of implements in which ingenious adaptation is the main characteristic, we have in this country a permanent first place. The processes of production are less expensive, and will be in future such as to overbalance the dearer material and greater expense charges. The success attained is pre-eminent in that class of machine tools, adapted to duplication, as in machine implements to produce firearms, watches, sewing machines, bicycles and hardware. The same remark applies to all kinds of hand tools.

Swiss and Scandinavian practice, though limited in extent, is highly commendable. Both of these countries have drawn copiously on American practice for "ideas," which have been, in many cases, especially in recent years, clothed in an unexceptionable design and mechanism that evince the influence of systematic training in the many and efficient technical schools in these countries.

There are, however, in all countries the same facts to be observed in respect to progress in machine tool making. Such progress has its initiative with those who purchase and employ machine tools. Such machines are an expensive commodity, and makers not only avoid innovations, but tardily follow the requirements of the users. This latter is perhaps because of machine tools being, as before mentioned, a product of the same processes which they are to perform, the user of a machine tool knows how it is made, practices similar operations; consequently is full of suggestions and able to dictate the construction of what he wants. There is also the impediment to change, of a strong tendency to reduce machine tool making to a "manufacture," and the disturbance caused by new designs, patterns, material and proportions has a serious effect on the cost of production; but all these things should not form a bar to the adoption of obvious improvements.

In England one man, Sir Joseph Whitworth, forty years ago, by his own efforts, raised the standard of machine work to a new plane by accuracy of fitting, the disposition of material and general design. This was, and is, generally acknowledged. His work was a striking example of what can be attained by the application of accurate and logical methods. In this country William Sellers & Co. are entitled to similar credit for having attempted, with less encouragement, to improve machine-tool practice, not only as to fitting, but also in design and in motions, that for a long time stood distinct, and then became a matter of emulation—in the end modifying the art all over the country. These are notable cases, and consist in each case of a wider application of organized skill applied in accordance with rules and principles of construction generally recognized and applied in other branches of like manufacture.

It is not contended that machine tool making can become so nearly an exact science as many other branches of constructive engineering work, but it can become systematic and a subject of discussion and research. There can be means of disseminating views and facts of interest and a better understanding, not only of machines, but of comparative practice; consequently, more uniformity of design and quality. There can also be standards of performance for turning, drilling, planing and milling. Such standards now exist in the most of the machine shops in England, in those branches and districts where wages are based on a definite amount of work measured by areas and divided into classes; a fact so carefully kept from public knowledge that inquiry usually will fail to elicit much information.

These lists, if known, would alone set up a measure of tool performance in regular processes, such as in planing, turning and finishing surfaces. They are an element in contract work now generally adopted in English machine-tool works, and are the secret of their competing with continental makers who pay much less wages for longer hours. As a matter of fact, most of the machine tool makers in England do not pay wages at all, in the common sense of that term. The workmen are co-contractors with the owners in the execution of the work; do their part in a careful and responsible manner for a stipulated portion of the contract price, carefully estimated at the beginning.

This system of paying for skilled labor is by no means that of "piece-work," because it affects every workman in a shop, and it has had much to do with the cost and character of the work produced. It has some parallels in this country, and is deserving of serious attention by machine tool makers.

Safe Loads for Helical Springs—II.

BY ROBERT A. BRUCE.

For many purposes the graphic diagram will be found of more service than the tables, its convenience lying in the fact that for all save hollow circular sections, calculations may be entirely dispensed with and a very simple measurement performed as a substitute. This is not the proper place to point out the process of its construction, which, so far as the author knows, is quite novel; but incidentally it may be remarked that the choice of scales and the methods adopted have been such as to secure one very important feature in a graphical solution, viz., equal percentage of accuracy on any part of the diagram.

This is one of the chief difficulties in all such diagrams. Another object which has been kept in view has been that all lines on the diagrams should be straight lines. It is hardly necessary to dilate on the importance of this point. Still one other point to be noticed is this, that the diagram can be used with as much accuracy for calculating the theoretical safe load on a spring of wire 1-100 inch in diameter coiled in a helix of ⅕ inch in diameter, as for a spring 1 inch in diameter coiled in a helix of 5 inches diameter. It has therefore far more elasticity than any tables can have. The diagram as it stands can be used without any measurement for all probable dimensions of round springs and a fiber stress of 40,000 pounds per square inch. For square springs and for other fiber stresses a simple measurement can be made on the accompanying reduction scales and applied to the scale of axial loads.

The diagram is so constructed that, by its use, either of the following questions may be solved:

(a) Given the dimensions (section dimensions and helical diameter) and the allowable fiber stress, to find the safe axial load.

(b) Given the axial load and one of the above dimensions, to find the remaining dimension, so that a given fiber stress is not exceeded.

(c) Given the axial load and the dimensions, to find the maximum fiber stress caused by such load.

Confining our attention for the present to round springs and a given fiber stress of 40,000 pounds, the simple diagram as it stands may be used thus: To find the axial load for a spring of given dimensions, find the diameter of section on the "section scale," and then follow along the horizontal line from the point so found to the diagonal marked with the helical diameter (or to the point, lying between the two nearest diagonals, marked, respectively, with a dimension next above and next below the required helical dimension). From this point of intersection follow vertically downwards to the scale of loads, paying proper attention to any remarks made on the diagram as to whether the reading should be read direct or multiplied by some factor, as explained on the diagram. (For instance, if the diagonals in the right-hand top corner are used, the loads should be divided by 1,000; if in addition the value on the section scale is read at 1-10, the diameter named as would happen in the case of very small springs, a further division of 1,000 should take place.)

Example—A wire of 87 inches diameter coiled in a spring of 5 inches diameter will carry a load of 2,000 pounds. The inverse operations need not be described.

The use of one of the reduction scales is necessary for round sections and other values of fiber stress than 40,000 pounds per square inch, or for other sections than round wire. As, however, the method of using them is identical for round or square sections, the description given for that marked "square" may be applied to both. Taking a simple measurement by marking a strip of paper, or transferring the same by a pair of dividers, is all the labor that is required.

To find the safe load carried by a square section spring of given helical diameter and allowing any value for the safe stress: Find the value of the safe stress on the reduction scale, measure the distance from that point to the vertical line marked zero, or 1. If this lies on the left of the safe stress, it is to be subtracted; if on the right, it must be added to the value on the scale of loads found as before.

Example—A square spring of $\frac{1}{2}$-inch side and 5 inches helical diameter is made of a material which can resist a fiber shearing stress of 50,000 pounds per square inch without taking a set. Find the maximum axial load.

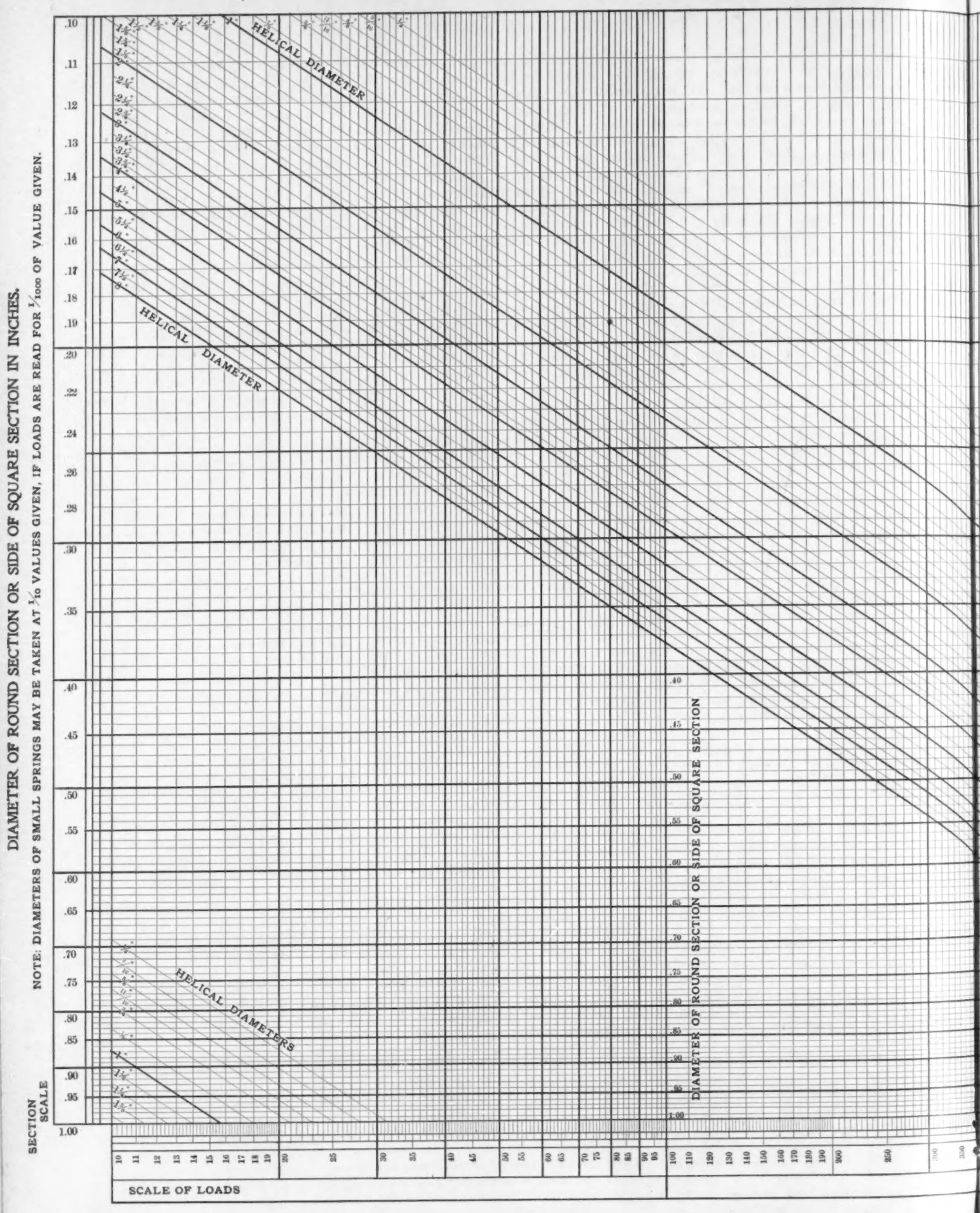
Firstly—Proceed as if the section were of ½-inch round wire, and find, in the way already described, the point on the scale of loads, viz., 390. Next use the reduction scale for square sections, taking a strip of paper or a pair of dividers and using them to find a point higher up on the scale of loads at a distance from the point 390, already found, equal to the measured length between the stress 50,000 and the zero line on the reduction scale. The new point thus found gives the safe load which the spring can stand, namely, 520 pounds. Had a stress of 25,000 pounds been chosen, the distance on the reduction scale from zero line to the 25,000 point, lying to the left of the zero line, the point found on the load line, would have been that distance measured to the left of the point 390, giving a safe load lying between 255 and 260 pounds.

In finding the dimension of the side of a square section spring, given the helical diameter and allowable fiber stress, for a given axial load, the process followed on the diagram is precisely the same as was described in the case of circular section, except that instead of reading the point on the load scale direct, a new point is found by aid of the reduction scale. In this case, however, the point is set off on the opposite side to that indicated in the preceding paragraph. Thus finding the axial load on the "scale of loads," a new point will be found on the right, if the measurement on the reduction scale is made to the left of the zero line, and on the left if the measurement on the reduction scale from the stress value to the zero line is on the right of the latter line.

This, of course, is only a way of saying what a little consideration would tell us, viz., that for a higher stress the dimension can be less than for a lower stress; and no confusion need occur in determining on which side the new point on the scale of loads is to be set off, if this simple rule is remembered, viz., for higher stress values the load is higher, for lower values of f the load is lower; or if dimensions are concerned, for the same load, the higher the safe allowable stress the smaller the section.

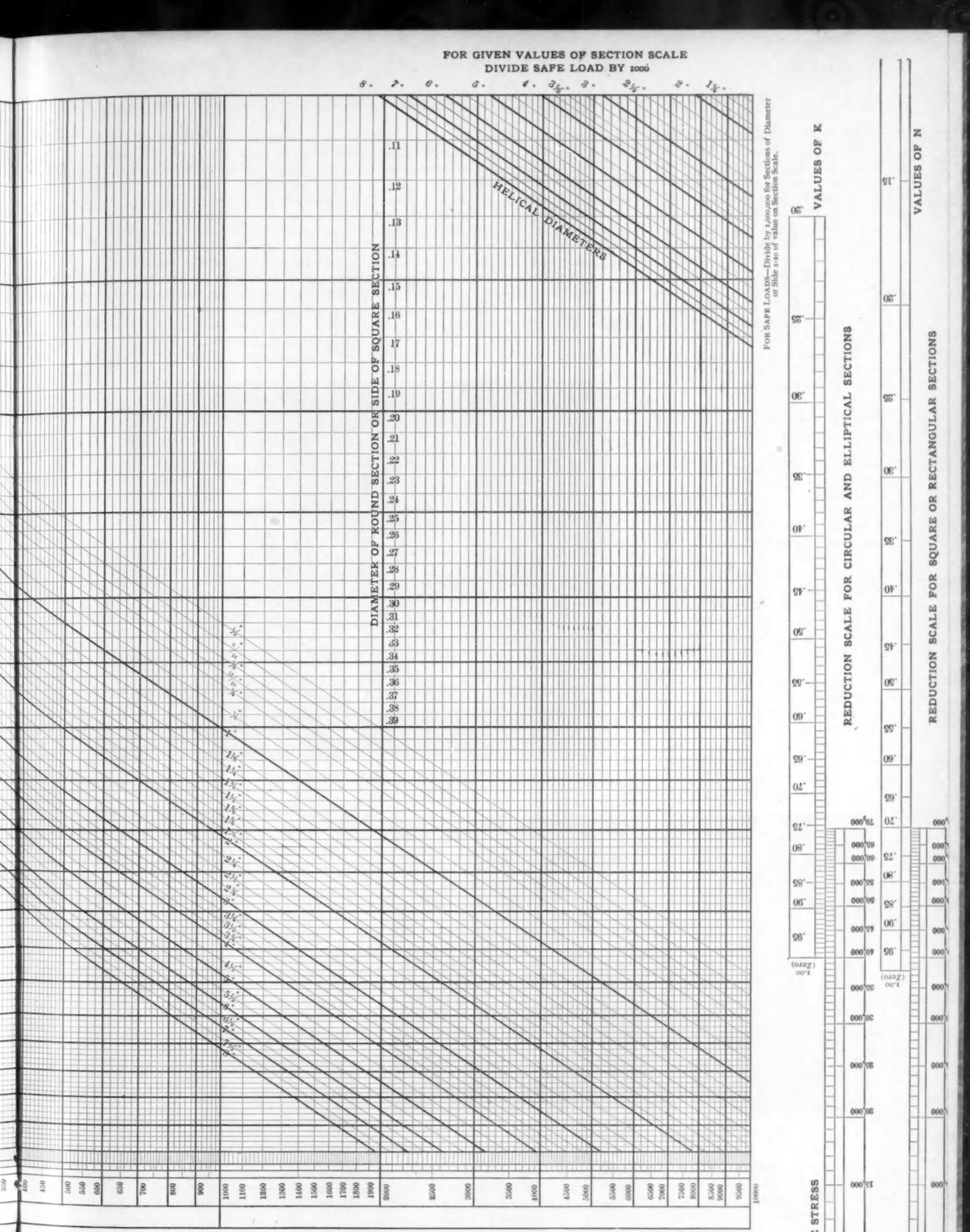
In dealing with the reduction scale for elliptical or rectangular sections, precisely the same rules apply as to the method of finding the point on the load scale, only in measuring the distance to be transferred to the scale of loads the distance is taken from the fiber stress to the point on the scale for the value of k, or n, which suits for the case in hand. For example, in finding the safe load on an elliptical section spring 1x¼ inch (here $k = .25$) with a helical diameter of 4 inches and a fiber stress of 50,000, the distance to be transferred to the scale of loads is that lying between 50,000 on the scale of loads and .25 on the scale of values of k. In fact, for the case in point the particular value of k suitable to the case is treated as if it were the zero line mentioned in the case of the reduction scales for round and square sections, and the same rules as to the direction in which the distance is to be transferred in finding the new load point apply. Similarly in the case of rectangular sections, the zero, from which a measurement is taken to the stress limit on the stress scale, is the value of n for the section in question. Thus, for a spring whose section is 2½ inches by ½ inch $n =$ .2, and if a fiber stress of 30,000 is used the distance to be transferred is the distance from .20 on the scale of values of n to 30,000 on the scale of fiber stresses.

It may happen that on transferring a point on the scale of loads by means of the reduction scale the new point desired may be found to be outside the limits of the scale. If this is the case the amount by which the new point lies outside the scale of loads may be transferred and used to find a new point inside the scale


DIAMETER OF ROUND SECTION OR SIDE OF SQUARE SECTION IN INCHES.
NOTE: DIAMETERS OF SMALL SPRINGS MAY BE TAKEN AT 1/10 VALUES GIVEN, IF LOADS ARE READ FOR 1/1000 OF VALUE GIVEN.
HELICAL DIAMETER
HELICAL DIAMETER
HELICAL DIAMETERS
DIAMETER OF ROUND SECTION OR SIDE OF SQUARE SECTION
SECTION SCALE
SCALE OF LOADS

Note for Diagonals in Bottom Corner—For Natural Values on Section Scale Multiply by 1,000 for Loads. If 1-10 Values on Section Scale Are Used, Read Loads Without Alteration.

SAFE AXIAL LOADS ON HELICAL SPRIN


FOR GIVEN VALUES OF SECTION SCALE
DIVIDE SAFE LOAD BY 1000
8. 7. 6. 5. 4. 3½. 3. 2½. 2. 1¾.
HELICAL DIAMETERS
DIAMETER OF ROUND SECTION OR SIDE OF SQUARE SECTION
.11 .12 .13 .14 .15 .16 17 .18 .19 .20 .21 .22 .23 .24 .25 .26 .27 .28 .29 .30 .31 .32 .33 .34 .35 .36 .37 .38 .39
FOR SAFE LOADS—Divide by 1,000,000 for Sections of Diameter or Side 1-10 of value on Section Scale.
VALUES OF K
REDUCTION SCALE FOR CIRCULAR AND ELLIPTICAL SECTIONS
VALUES OF N
REDUCTION SCALE FOR SQUARE OR RECTANGULAR SECTIONS
FIBRE STRESS
American Machinist

SPRINGS IN POUNDS. Maximum Fiber-Stress 40,000 Pounds per Square Inch for Round Sections Only. For Square Sections and Other Fiber-Stresses Use Reduction Scale.

in a manner which is best explained by an example. Suppose a point so found lies outside the scale on the lower side so that it is 1 inch away from the line marked 10; then by transferring the distance and measuring downwards from 10,000 (the highest point on the scale) a new point is found giving a new reading. On dividing this reading by 1,000 the required load is obtained. On the other hand, suppose the point to be outside the upper end of the scale at a distance measuring *y* inches above the point marked 10,000. Find a point above 10, measuring from the point marked 10 a distance of *y* inches. The scale reading for this point multiplied by 1,000 would be the reading sought. For most practical cases, however, the scale values given are sufficient.

New Brompton, Kent, England.

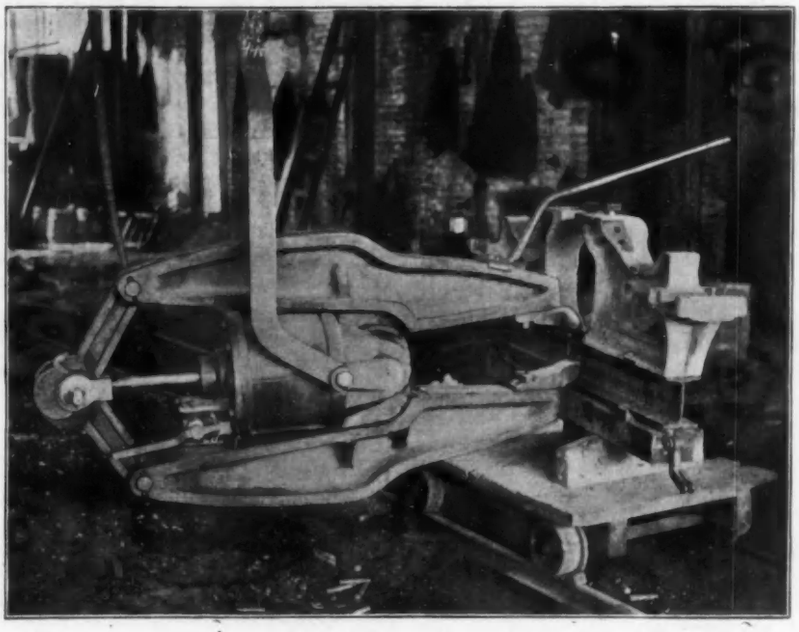


FIG. 1. ALLIGATOR RIVETER WITH JAWS OPEN.

A Pneumatic Riveter and the Actual Cost of its Operation.

The accompanying half-tones show a pneumatic riveter as actually in use in a shop of the Reading Foundry Company, Reading, Pa. It is called an "Alligator" riveter, from its resemblance to the jaws of the well-known saurian, and is made by the Bethlehem Foundry & Machine Company, South Bethlehem, Pa. As here shown, it is employed in riveting sections of I-beams to the under sides of cast-steel yokes for the subways of underground trolley lines. Ten ⅝-inch rivets are used in each casting. The operation of the riveter needs scarcely a word of explanation. The riveting is done by a simple squeeze, the levers being opened and closed by the piston which operates the toggle joint at the back.

Fig. 1 shows the jaws open, and Fig. 2 shows the completion of the riveting operation. The job here shown is not fine work. The rivet holes are cored in the casting, and they are punched in the I-beam. The casting is placed upon the I-beam, and two or three taper pins are dropped into holes to keep the pieces in proper relative position. A hot rivet is then dropped into one of the holes by the heater-boy, the jaw of the riveter is brought down upon it, and the air being turned on by the little valve seen near the lower left-hand corner of the cylinder, the piston rod pulls the members of the toggle joint to nearly a straight line, and the riveting is done. A reversal of the lever drives the piston in the reverse direction, and the jaws are opened to their full width, ready to attack the next rivet, and so on. The gang of four boys, as shown, have driven 2,000 rivets per day of ten hours.

FIG. 2. A STEADY JOB OF RIVETING.

The total length of the riveter is 5 feet, hight 34½ inches, width 21½ inches, and weight 1,500 pounds. The reach at the center of the jaw is 20 inches, diameter of cylinder 12 inches, stroke of dolly bar 3½ inches. With the exception of the cylinder and piston and a few of the smaller parts, the riveter is made of steel castings throughout. The machine is well balanced and easily handled, and will drive any size of rivet commonly used in bridge and shop work. The makers of the machine offer the following to give some idea as to how the use of this machine compares in economy with hand work:

Hand Work—Two riveters and one holder-on drove 250 rivets per day of ten hours

Machine Work—Two men, not skilled riveters, and two boys drove 250 rivets per hours.

An interesting question not generally discussed with any care is as to the actual consumption of air, or the actual power cost of operating this or similar machines. The pressure of air usually carried for this and similar shop tools is from 60 to 80 pounds gage. Five cubic feet of free air is used for each stroke of this riveter, or for each rivet. Then for 2,000 rivets per day of ten hours 10,000 cubic feet of free air would be required. To liberally cover all contingencies this volume may be doubled, making 20,000 cubic feet of air per day, or, say, 34 cubic feet per minute. With the average compressor in common use (not the best compressors) one horse power will compress about 5 cubic feet of free air per minute to a pressure of 75 pounds, so that the power required for operating this machine would be about 7 horse-power. As to the cost of the power beyond this it is not necessary here to go into it, as this varies so much with the style of engine or other means of power development. The coal cost per horse-power might range between 2½ pounds and 10 pounds, or far beyond the latter figure.

Molding a Wheel Segment.

BY R. H. PALMER.

Let us look at the manner of molding a segment of a driving wheel of a large Corliss engine. The segment is shown in Fig. 1, the wheel being 30 feet in diameter and 72 inches face, and the number of segments eight.

We take binders of cast iron *X X*, Fig. 2, the ends of which are seen sticking out under the end of flask, and also at *C X X*, Fig. 6.• Cutting two channelways in the floor, we sink these binders so that their tops are even with the floor-line, C X C, Fig. 6, leveling them lengthways and crossways, so that when we put the bottom board down on top of them, it will not rock; bringing the center of board to center between binders, placing the binders far enough apart so that they will come outside of the two inner ribs *H H* of the segment pattern, Fig. 2.

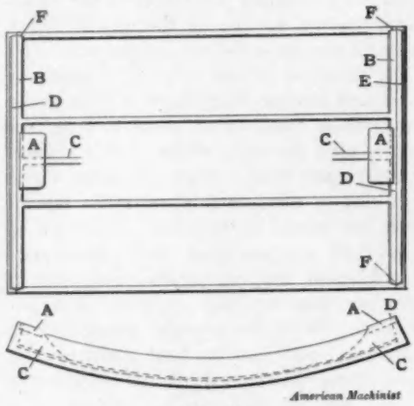


Fig. 1

THE SEGMENT TO BE MOLDED.

We then take the drag, Fig. 3, and turning it on its side, nail blocks of wood *G*, Fig. 6, on that edge, just tacking them on and leaving between the blocks spaces *F*. We then place the drag on the board, Fig. 6 (imagining all above line *H, H, H* were left off). Next we take rods of iron, say 5-16 inch diameter, and run them in between bottom board and drag, through spaces, *F*, Fig. 6, letting the rods lie on the bottom board, putting two or more in each place, the rods reaching to a little more than the center of the flask, and put in from each side. Cinders may be used in place of these rods.

We next place two timbers, *P, P*, Fig. 3, coming up to the right night, for guides *A*, Fig. 5; also *J*, Fig. 3, to rest on, being sure that they are level. We also put them as near to the side of the flask as we can have them and yet have room to work a strike *R*, Fig. 2.

We also bolt the guides to the sides of the flask with bolts *S*, Fig. 2, letting the bolts run through the blocks *T, T*, Fig. 2, which keep the guides in place; also we let rod *N*, Fig. 3, run through center of flask from side to side, to keep it from spreading while pouring.

We now shovel in the sand, properly tempered, and ram it up as solid as we can, nearly to the top of the guides *O X X*, Fig. 3. We next take strike *A*, Fig. 7, and, using the side marked *B*, strike the sand out between guides *R, R*, in Fig. 2, to a depth of 1½ inches. We then take our vent-wires and give it a good venting, being sure to send the vent-wire down to the bottom board on which the vent rods, before mentioned, are lying. To have the vent-wire go through this mass of hard-rammed sand comparatively easy, take it to a vise and upset a head on it. The wire will pass through the sand with about one-half the exertion needed if a sharp vent-wire is used.

We next take a facing mixed of 1 part of bituminous coal, ground to what we call "coarse," or "gunpowder," and 5½ parts of good coarse molding sand. Have the facing well mixed, and spread it over the surface you have vented a little more than 1¼ inches thick. Then take strike, Fig. 7, side *C* (this edge of strike being left square, not beveled as the other edge), and holding a piece of wood ¼ inch thick under the end of the strike, and letting this piece run on the guide, this will keep the strike ¼ inch above guide; and as this side is notched ½ inch, where the first side used was notched 1½ inches, it will leave the facing sand evenly spread over the surface of the bed, 1¼ inches thick.

Now, if you wish, take a fine wire and go over it; but if you have a good coarse sand that vents easily (and if you have not, you had better get it), there is no need of it, and especially if you have put the vents in your bed as thick as you ought. Then let two men take this same strike, using this side *C*, Fig. 7, and, starting at *R*, Fig. 3, one man holding his end of the strike down on the guide *J*, Fig. 3,

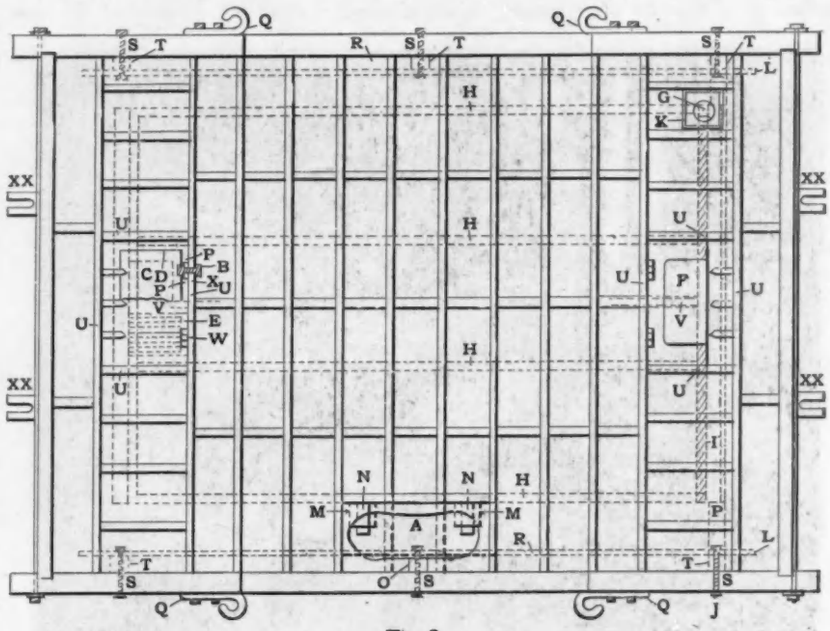


Fig. 2

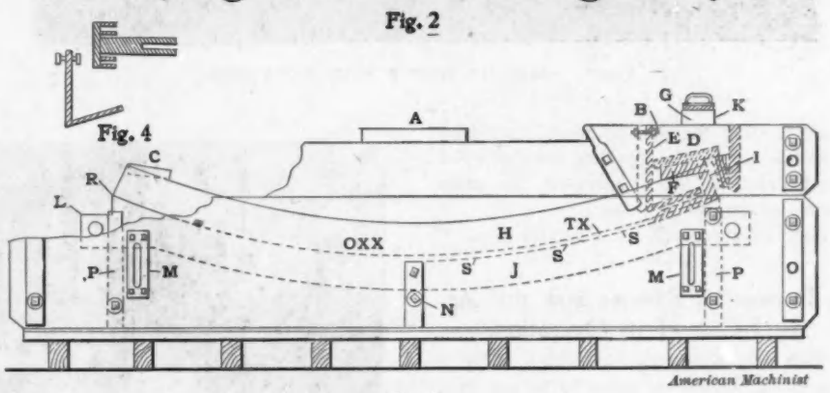


Fig. 3

MOLDING A FLY-WHEEL SEGMENT.

at a little below R, the other commences to pound down with his end, advancing a little at a time until he can go no farther and keep on the guide. Then he stops and the other man pounds down on his side, advancing all the time, the first man holding his end down, and so on until the ends of the guides are reached. It takes but a short time to do this, and when it is done, if care is taken, the bed is equally hard all over. Now keep your trowel in your box or pocket, and don't go and slick this surface.

Take the segment pattern and place in position on this bed *S*, Fig. 3; then put a

few pieces of pig iron on it to keep it from shifting. One of the two molders on the job takes the two runner cores *M, M,* Fig. 2, with runners seen running through them, and places them in position, raising the runner above the bottom of pattern, or off the bed, say, ¼ inch, so that when the iron enters the mold, it will not be playing or washing directly on the surface of the mold. Many a time a surface will scab badly when the iron plays directly on it, while if the runner is raised a trifle above this surface, scabbing is prevented.

The gate-sticks are set, and the sand on the sides of the pattern is rammed up to the top of the side flange. The joint is then made. We then place the loose ends of the pattern in for good, or I should have said they were in place while the sides were being rammed up; then cover the pattern with about ¾ inch thickness of facing. The cope, having been wet down and claywashed, is lowered on to the drag *I X,* Fig. 3. We next gagger the cope well. Don't try to carry too big a bag of sand with a short gagger; better make a few gaggers, if in a shop where cast-iron ones are used and each man makes his own, than to spend your time

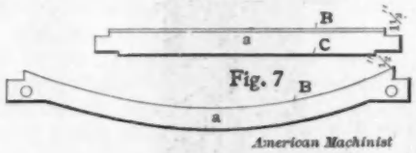


Fig. 5

looking around the shop to try to borrow from somebody while he is not looking. After the cope is gaggered, tuck the bars well and ram it up to the top of the ribs of the pattern, except pockets on sides of center ribs *V,* Fig. 2, and vent at ends where a sort of pocket is formed by the loose pieces. Next take four carcasses, or crabs, or skeletons or whatever name you choose to give them, *B* and *A,* Fig. 4, placing one on each side of the center rib *V,* Fig. 2, shown dotted in *W,* Fig. 2, also shown at *E,* Fig. 3; and after placing them in position, take the bolt *B,* Fig. 3, and passing it through slot *W,* Fig. 2, then through bar of flask *X,* Fig. 2, and tightening nut, we then have the arrangement shown in *B,* Fig. 2, and *B,* Fig. 3. In this way we have bolted these four carcasses solid to the bars; so we have a carcass to lift the pocket and carry it, and in pouring to stand the upward strain on the pocket. We ram up these pockets, using cinders to form channelways to bring off vent from pocket to vent-holes up through cope formed by ramming up rods and afterward drawing them out (*P, P,* Fig. 2), using additional rods to strengthen these pockets. Having now rammed up the pocket to the top of the rib, shown dotted in *V,* Fig. 2, remember to use the vent-wire well to vent the top of pocket well to channelways. We next take pad *F,* Fig. 2, and gently rap it down to its bearing or seat in the pattern, then make a parting around it to make a bearing for covering core *C,* Fig. 2, under which the pad will be seen dotted in. Take out this core after seeing that it bears right, throw a piece of bagging in on top of it, and ram up the rest of the cope; then vent well all over, being sure the vent-wire goes down far enough. Take out the bagging, clean out any loose sand that may have fallen in, draw out the pad, and finish as well as possible the pockets. Put on the covering core, and ram the sand over it, leaving the vent rods in to bring the vent from the channelways to top of cope. Rub a board to a bearing over this. You can have the board long enough to go under the long top binder, and wedge it, or you can weight it or screw it to cross-bars, so that it will stand the strain of pouring. Leave the vent-rods in until you put on the cope for the last time, then be sure and take them out. If you leave them in while pouring, or those between board and drag, you will remember for some time what a choked vent means, for you will have the segment to make over.

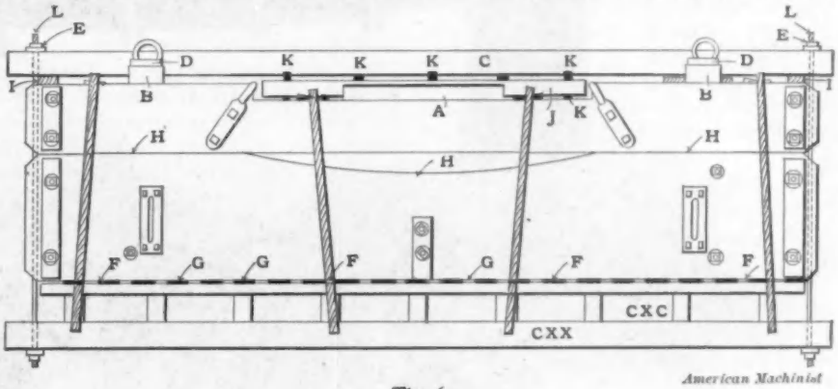


Fig. 6

THE MOLD COMPLETE.

Be sure and vent any mold well, provide plenty of ways for vent to escape, only look out the iron don't escape where the gas should; or, as one helper said, "Don't have a riser on the bottom board." Having hoisted the cope off, lower it on horses and finish it overhead, drawing out the loose end-pieces that were lifted in the cope from the pattern in drag. Be sure those nuts are tight that hold those crabs before you start that cope.

The drag is then to be finished. In doing this, don't take your trowel and slick, slick, until you can nearly see your face in the surface of mold. Many times you will get a better surface on a casting by leaving the mold as nearly as possible as the sand is packed on the pattern in ramming up, of course mending where the mold breaks in drawing the pattern. Some persons will kill a mold in killing time finishing it. After finishing the mold, in the drag in front of the gates we press in nails, say, 1¼ inches long, with large heads, letting the heads come even with the surface of mold; this is done to keep the mold from cutting in front of the gate. We next black the mold with "silver lead," as we call it.

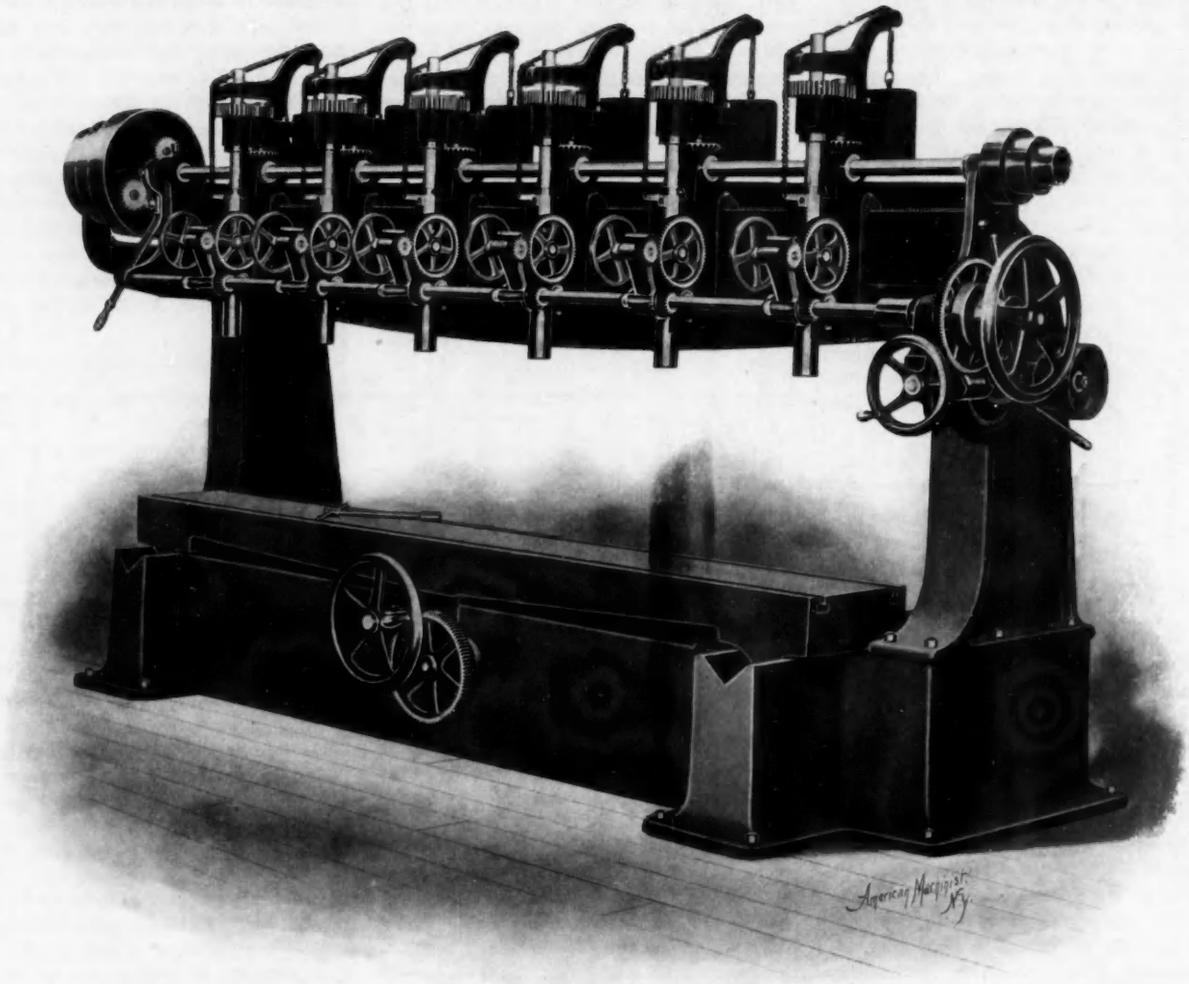
Now having drawn out the gate-sticks and cut runners to connect the gates, and having hitched on to the cope, and lifted it off the horses, and built the runner basin A, Fig. 2, and A, Fig. 3, also riser boxes *B,* Fig. 6, we put flour or parting sand on the joint and try the cope on, finding that it bears as it should, and is not crushed anywhere, we lower it on for good. We take blocks of iron, made for the purpose, and place them on the ends of the flask for the binders to rest on *I,* Fig. 6; this raises the binder far enough away from the cope bars, so that we can wedge between the binder and the bars. We next take rods *L,* Fig. 6, and with them bolt the binders together. The cope drawn here is lower in the center than at ends, and the runner box is built up. Joists of wood are used in the center between the binders and bars *J,* Fig. 6, and wedges are used between these timbers and bars, also between timber and binder, *K, K, K,* Fig. 6. By this arrangement these binders, which are made heavy to stand the strain, and not spring, take the strain upward in the center of the flask; for, no matter how firmly the sides of the flask are clamped, unless the bars of the flask are extra heavy, there will be a give to the center of the flask when we come to pour, which would make the casting thicker in the center.

Wheels with wider faces than the above, and up to 108-inch face, have usually two sets of arms; the manner of molding is the same, but they are poured with two ladles, one on each side, so as to fill the mold as quickly as possible, as, if a mold is too long filling the cope is sometimes "drawn down," as it is termed by molders.

Seven million tons of liquid fuel are consumed in Russia per annum. Eight vessels engaged in the Eastern trade are fitted for it, while not only are others under construction, but several coal burning ships are being altered to adapt them to the use of oil. Tanks for fuel oil have been erected at ports ranging from Yokohama to Suez, including all Indian ports.

New Six-Spindle Drilling Machine.

The accompanying cut illustrates a six-spindle drilling machine recently built by the Bickford Drill & Tool Company, Cincinnati, Ohio. The machine is capable of drilling, simultaneously, six 1½-inch diameter holes through steel. The spindles are provided with both hand and power feed, quick advance and return, and automatic stop, and may be operated independently or collectively as desired. They are driven through a double set of planetary gears placed within the cone, an arrangement permitting the back gears to be engaged, or disengaged, by one movement of a lever. The spindles have a vertical movement of 8 inches, and will drill to 6 inches, center-to-center distance. The rail is made in various lengths in order to accommodate two, four, six or eight heads as may be desired. The machine is furnished with either a plain or an adjustable table, the distance of which from nose of spindles, when at extreme hight, is made 18, 24 or 30 inches, according to the nature of the work upon which the tool is to operate. Three larger sizes are built, the largest of which has a spindle 2½ inches diameter, with vertical feed of 22 inches.



SIX-SPINDLE DRILLING MACHINE.

Boilers in Great Britain.

For some twenty years there has been going on a steady rise of steam pressure. This is partly due to a demand for it, and partly to the introduction of forms of furnace tube which have enabled tubes externally pressed to carry the same pressure as boiler shells. While this has been going on there has been a section of the engineering world who have believed, or who have stated that they have believed, that the limit of pressure has been reached for shell boilers, and they have strongly advocated water-tube boilers as alone suitable for modern high pressures. It seems very far back when I first heard that shell boilers could no longer be trusted to carry higher pressures. Those were the days when boilers were made 7 feet diameter. They had iron plates about 7-16 or ½ inch thick, and the rivet holes were punched. But steel was introduced; rivets were mechanically driven in drilled holes; new forms of furnace tube jointing were invented, and the large shell boiler has steadily grown in diameter, thickness, quality of material and excellence of workmanship, and is safer to-day than it was twenty years ago. The oldest boilers that I have seen at work were composed of plates about 3x2 feet. Some, I believe, were still less, and doubtless many such boilers are still at work in odd places.

As showing to what modern construction has attained, I may mention the record of to-day in Lancashire boilers. The record boiler measures internally 30 feet long and 9 feet diameter, and the shell is made of four plates only, each 29 feet 1½ inches long by 7 feet 9½ inches wide, and 15-16 inch thick, being the largest plates ever used in a Lancashire type of boiler, though plates 12 feet wide are contemplated. The front end plate is 10 feet 3½ inches diameter, in one piece, and attached, as usual in Lancashire practice, to the shell plate by outside angle irons, the back end plate being flanged and attached inside the shell plate. There is another plan, sometimes followed, of flanging the front end plate also, and in this case the edges of the flanging are directed outside. The furnaces have a diameter of 45 inches, and they are welded and 19-32 inch thick, and stiffened by being pointed with the Adamson flanged seam. There are fourteen such

seams in each tube. The furnace tubes, of course, perform the duty of stays between the boiler ends, and no longitudinal bar stays are employed, but the end plates, which are 13-16 inch thick, are stayed to the first ring of shell plating by five gussets at each end, above the furnace tubes, and three at the back, and two at the front below the tubes, the place of the front lower middle gusset being taken for stiffness by a stout mud-hole mouthpiece, double riveted. The angle iron of the front end plate attachment to the shell is 6x6x¾ inch, the double angle irons of the gusset stays being all 5½x5½x¾ inch. All angle irons are double-riveted to the parts they connect. The fittings are carried on steel mounting blocks. The longitudinal joints of the shell plates are double-strapped and quadruple-riveted.

By customary English practice the boiler is looked upon as proper for 200 pounds working pressure. Probably the steel of which it is made has an ultimate tensile strength something under 70,000 pounds per square inch. A few years ago it was customary to ask for it below 60,000 pounds, but such extreme softness is not so much insisted upon, and higher tension is allowed. The test pressure would be 300 pounds, or one-half only above the working pressure, a margin amply sufficient to prove good workmanship, and not sufficient to cause undesirable stress, such as too frequently is caused by injudicious application of the hydrostatic test without care or judgment. The pressure of 200 pounds may be compared with the pressures allowed in America by the Board of Supervisors, where pressure allowances were—if they are not still—very much in excess of the pressures looked upon as proper on this side. It is thus obvious that, so far, the competition in pressures has found makers of shell boilers prepared to supply progressively better and stronger boilers as the demand for them has been made.

Their rival, the water tube boiler, on the other hand, has also made progress. In its early form it was a built-up agglomeration of small shells, water tubes and a lot of cast iron connective pieces, and being nowhere of large diameter it was claimed to be safe. To-day, however, the stresses on the steam drums of water-tube boilers are greater than were the stresses on the shells of Lancashire boilers when those were pronounced played out, and in its turn the water-tube boiler has been remodeled, its riveting has been improved, its cast iron heads abolished, and generally it has been made to conform more closely to good constitutional practice. Each type of boiler has its advocates, the water-tube being held capable of being more quickly got under steam from a cold state, and the shell boiler being claimed as more steady under variable load by reason of its larger store of heated water. Structurally the art of boiler making is on a very high plane. The steam boiler is a machine-made structure from end to end; all plates are edge planed; all holes drilled, or, if large, cut out in a lathe or mill, and rivets are machine closed throughout, and, while the material of to-day would stand drifting, the drift pin is never required, all parts being made accurate to size.

W. H. Booth.

London.

Letters from Practical Men

Windmill Inefficiency.

Editor American Machinist:

Of all the mechanical devices in operation at the present time it seems to me that the windmill is the one most absurdly behind the times as a machine, and most to be condemned for its inefficiency. I know that the windmill builders will be ready to jump on me, and to tell me that I don't know anything about the matter, but there are so many things about which I know so little that I am not much upset any more by being reminded of it.

Now, I believe in windmills; not, of course, for everything or everywhere, but in their place, for small and intermittent service in isolated spots, on the farm or near the country residence, along the coast or on the prairie, where the breezes are constantly looking for something to do, and work just as well nights and Sundays. I believe they ought to be given a fighting chance, and it seems to me that they certainly have not got it yet.

A century ago, in Holland or in England, the windmill furnished a much larger proportion of the mechanical power used by the community than it does to-day. The venerated mechanics of those days found out what was in it and ran it "for all there was in it." Maybe they did. Their modes of governing the wheel tell the story. The wheel was calculated to do a given amount of work at a given speed, when the wind was not overstraining itself. If the wind at any particular time manifested a more industrious disposition, it was never permitted to do more than its allotted work. When, as it often happened, they had more wind, or power, than they had made arrangements to use, they would either apply a brake to the shaft or they would furl a portion of the sails, like they do on a ship. The old windmill with its four long arms was a picturesque object in the landscape, and this picturesqueness was sometimes punctuated by the furling of, say, a third of each of the sails when the breeze freshened, and if the wind got still stronger they would furl another third of each sail. The use of the brake or the furling of the sails must strike any mechanic as a most neat and beautiful way of taking advantage of the wind, and of getting all the power that it was possible to get out of it.

The really striking thing about it is that they operate windmills in just the same way to this day. They don't use the brake, I suppose, but they do use the other device of furling the sails, or, what is the same thing, making the vanes less effective as the wind blows harder. A windmill is popularly believed to be a device for applying the force of the wind to practical uses, such as the pumping of water, the grinding of corn and similar services. The impression so common is not a correct one. The windmill is a device for deliberately and functionally throwing away power. The governing of the most modern windmill, as of the most ancient, is done by throwing away all the wind power above that of an average breeze. I know very well that the operation of any of our power-developing devices, steam engines, water wheels, or what not, is attended with more or less waste or loss of power, but none, except the windmill, makes the throwing away of power a part of its regular business. A steam engine, if there is 100 pounds of steam available at the boiler, does not undertake to run with 25 pounds of steam and govern itself by throwing away the excess of pressure. The steam engine and the water wheel govern by saving the excess, but the windmill governs by throwing the excess away.

It may easily be said that there is no other way to govern a windmill, but it is not easy to believe it. If the wind increases so that, in the natural course of events, the wheel should have more power, can't it have more work to do? Especially when employed in pumping, this would seem to be an extremely easy thing to do. If the wheel at any time can pump more water, let it pump more. A water pump is just as efficient no matter what the clearance may be; so that all there is to do is to change the stroke of the pump, by the use of a lever with an automatically changeable fulcrum, or some equivalent device. One of the best wheels in the market, excellently made and largely used in pumping, really disgraces itself, in my estimation, by operating a pump with unchanging stroke and with a constant head to the water. When, as is constantly occurring, the wind urges this wheel to run faster, or to do more, it simply turns itself cornerwise to the breeze, and more and more so, until it becomes sufficiently inefficient to maintain its accustomed jog trot.

Now, this is distinctly discouraging, and especially so when we try to think of some scheme for storing the windmill power. It is not easy to make a neat connection between the purpose of storing or saving power and the practice of rejecting or throwing away power which is distinctly and indisputably offered to us, or, as you might say, thrown at us. There must be really a chance for some good inventive mechanic to do something more than has been done with windmills. They, of course, will never cut any enormous figure in the sum total of power used in the world, but they will continue to hold and

occupy a field of their own. The windmill business, as a whole, is probably as good as it has ever been, and will doubtless continue as long as the winds blow; and if the windmill is made largely more efficient, as it certainly looks as if it could be, its sphere of usefulness would of course be proportionately enlarged. As to what is its full field cannot be told until it is fully prepared to occupy it.

TECUMSEH SWIFT.

Rational Measurement of Screw Threads.

Editor American Machinist:

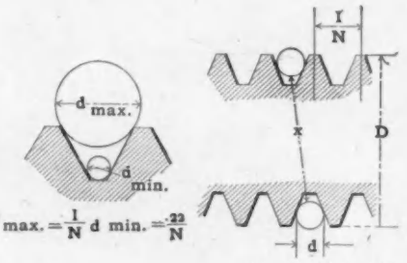
The necessity for a rational method of measuring the diameters of screws is evident to all who have given the subject any thought. For comparative purposes many have used spherical pointed calipers, but I am not aware that this method of measurement has ever been employed except in connection with a reference gage. It was to prove the inaccuracy of such a gage that the following formula was derived, and it has proved so useful that the accompanying table was computed, covering all U S. Standard threads and some special sizes which arise in our work.

It is unnecessary to dwell upon the advantages of such a table, and I forward it in the belief that it will be a welcome addition to the data of many mechanics.

Derby, Conn. V. C. TASKER.

x = Distance between ball points.
D = Outside diam. of U. S. Std. thread.
d = Diam. of ball points.
N = No. of threads per inch.

$$x = \sqrt{\left(D + 2d\right)^2 + \frac{2.547 - N(6.06235d + 3.031175\,D)}{N^2}} - d$$



$$d\ \text{max.} = \frac{1}{N}\ d\ \text{min.} = \frac{.22}{N}$$

D Inch.	N	x = DISTANCE BETWEEN BALLS. d=.04 Inch.	d=.10 Inch.	d=.18 Inch.	d max. Inch.	d min. Inch.
¼	20	.2154			.05	.011
5-16	18	.2701			.055	.012
⅜	16	.3219			.062	.014
7-16	14	.3707			.071	.016
½	13	.4250			.077	.017
9-16	12	.4777			.083	.018
⅝	11	.5292			.091	.020
¾	10	.6403			.100	.022
⅞	9	.7480	.8083		.111	.024
1	8	.8527	.9124		.125	.027
1⅛	7	.9610	1.0100		.143	.031
1¼	7	1.0757	1.1356		.143	.031
1⅜	6	1.1654	1.2250		.166	.037
1½	6	1.2910	1.3504		.166	.037
1⅝	5½		1.4521		.182	.040
1¾	5		1.5316	1.6297	.200	.044
1⅞	5		1.6748	1.7545	.200	.044
2	4½		1.7665	1.8463	.222	.049
2¼	4½		1.9950	2.1019	.222	.049
2½	4		2.2245	2.2963	.250	.055
2¾	4		2.4749	2.5540	.250	.055
3	3½		2.6708	2.7505	.285	.063
3¼	3½		2.9206	3.0003	.285	.063
3½	3¼		3.1375	3.2172	.307	.068
3¾	3		3.3489	3.4287	.333	.073
4	3			3.5987	3.6785	.333	.073
4¼	2⅞			3.8269	3.9085	.347	.077
4½	2¾			4.0529	4.1328	.363	.080
4¾	2⅞			4.2765	4.3402	.380	.084
5	2½			4.4973	4.5612	.400	.088
5¼	2½			4.7480	4.8270	.400	.088
5½	2⅜			4.9663	5.0461	.421	.093
5¾	2⅜			5.2163	5.2960	.421	.093
6	2¼			5.4310	5.5109	.444	.098

SPECIAL DIAMETERS.

Inch.		Inch.	Inch.		Inch.	Inch.
.72	18	.6763			.055	.012
.722	18	.6783			.055	.012
.726	18	.6823			.055	.012
1.06	18	1.0162			.055	.012
1.252	7	1.0778	1.1287		.143	.031
1.255	7	1.0808	1.1317		.143	.031
1.256	7	1.0818	1.1427		.143	.031
1.50	12	1.4140			.083	.018
1.61	18	1.5660			.055	.012
2.40	8	2.2513	2.3112		.125	.027
2.585	7	2.4095	2.4694		.143	.031

TABLE FOR SETTING BALL-POINT CALIPERS FOR U. S. STANDARD SCREW THREADS.

Holding Lathe Work Back on Center.

Editor American Machinist:

I would like to suggest to readers of the "American Machinist" a way of holding work on centers while steady-resting, to bore or perform some other operation on the opposite end.

The method usually employed is to unscrew the face-plate part way, and then by means of a belt lace or other string tie the work to the plate, and then screw it up to the shoulder, thus drawing the work on the center.

Of course if the lace or cord stretches and the work gets loose on the center it is liable to be spoiled, especially if a thread is being cut in the other end.

A simple and very effective device, which I have used for several years and which has never failed to give good results, consists of a spiral extension spring, having a convolution on each end, bent over at right angles to the length of the spring, and having their edges at right angles to each other, one end forming an eye to hook over the set-screw in the dog; the other end passing through a slot in the face-plate; a straight piece of stiff wire passed through the eye here prevents it from pulling out. The spring should be of such length that when work is straight between centers there is tension enough to keep it firmly against the center. This spring is easily and quickly made, and several sizes may be kept on hand to suit different sizes of work and machines. In this way the work may be taken from the lathe for any purpose that may be necessary and replaced almost as quickly as if it were merely placed on centers.

WM. H. WELCH.

A New System of Bevel Gear Making.

Editor American Machinist:

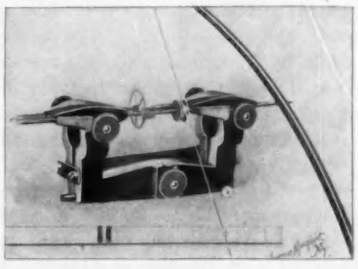
In your issue of April 6, 1899, you published an article under the above heading, describing a system of finishing the shape of epicycloidal [Octoid.—Ed.] teeth by a file cutter, which method you claim to be entirely new.

Allow me to inform you that this method of finishing the shape of wheel teeth was invented by Pierre Frederick Ingold, of Biel, Switzerland, a remarkable watchmaker, inventor and pioneer in manufacturing watches by machinery, more than forty years ago, and it has been in use ever since by first-class watchmakers.

The accompanying photograph shows the way it is used in horology. The two parts, viz., the wheel, whose teeth are to be finished, and an "Ingold fraize," as it is called, are put in the depthing tool and the cutter put into gear with the wheel. The cutter being rotated by the aid of a bow and brought nearer to the wheel, will finish and equalize the shape of the teeth of the wheel.

There are about seventy-two cutters in a complete set; they are hard and the wheels used in horology being of brass, perform their duty well. One of the cutters is shown endways at the right hand lower corner of the tool in the photograph.

The cutter is cylindrical, and, of course,



THE INGOLD SYSTEM OF SPUR GEAR CUTTING.

can only be used for a wheel with the same kind of tooth. Mr. Berlioz, in order to reduce the number of cutters required by the watchmaker, gave it the shape of a cone so that it was possible to use one cutter for a number of wheels. This, however, has the disadvantage of making a conical tooth, and on that account it is seldom used in horology.

The system was described in German and French horological trade papers many years ago, and it is surprising that it

should never have attracted the notice of the "American Machinist."

Any reader of the "American Machinist" who should happen to be in Philadelphia can inspect a set of such cutters by calling on me.

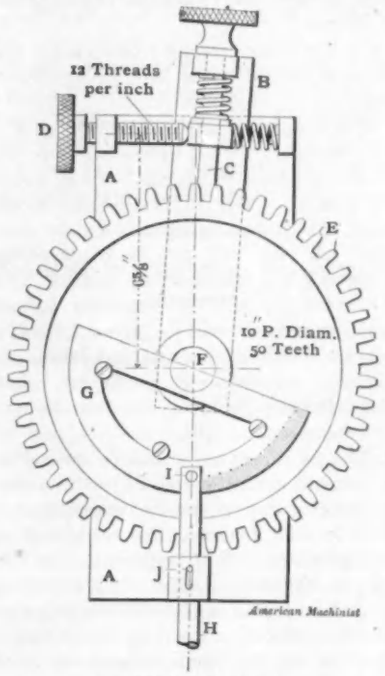
FERD. T. HASCHKA.

The Baily, Banks & Biddle Co.,
Philadelphia, Pa.

An Example in Dividing.

Editor American Machinist:

I have been much interested in the descriptions of the various methods of dividing a circle which have appeared lately in the "American Machinist," and I am reminded of some efforts in this line with which I was connected. We wished to divide a semicircle into 250 parts, and the sketch shows the "dividing engine" which we rigged up for that purpose. *A* is a base-plate intended to be held in a vise. It is provided with an arm *B*, free to swing around a stud *F*, which is fixed into the base-plate. This stud was turned to fit the hole in the gear *E*. On the arm *B* we rigged a stop *C*, which would fit snugly between the teeth of the gear and be held there by a spiral spring. This gear of 50



A DIVIDING SCHEME.

teeth which we found in the shop was really the vital part of our device. Half of the circumference of this gear gave us 25 teeth, and dividing each of these by 10 gave 250, the number required. We accomplished this division by a screw *D*, placed at such a distance from the center *F* that one turn of the screw would push the arm *B* one five-hundredth of a complete revolution, and after ten turns, or one-fiftieth of a revolution, we drew out the stop and allowed it to drop into the next tooth, which we divided in the same way. The distance of this push-screw from the center of the gear might be expressed thus: $\frac{10 \text{ (turns of the screw)}}{12 \text{ (threads per inch)}} \times 50$ (teeth) equals 41.66" (circumference), and the radius of a circle of 41.66 inches circumference is 6⅝ inches, which is the distance required. The work to be graduated, *G*, was coated with wax, and was fastened to the gear *E*, so as to turn with it. The marking was done by a needle-point *I*, on the rod *H*, which cut through the wax, so that the metal could be etched out with acid, as is usually done with this class of work. The needle-point *I* was kept upright, and the length of the mark governed by a pin playing in a slot *J*. Now it may be argued that this is only a "cub's" device, that the inaccuracies and wear of both the screw and the gear will be added to whatever defects there may be in the workmanship to defeat any approach to perfection in the product; but it will be noted that only a few threads of the screw were used, that the gear was of fair size, and that such gears are now exceedingly accurate and that the work was small enough so that these inaccuracies were reduced to very much less than the width of the lines themselves.

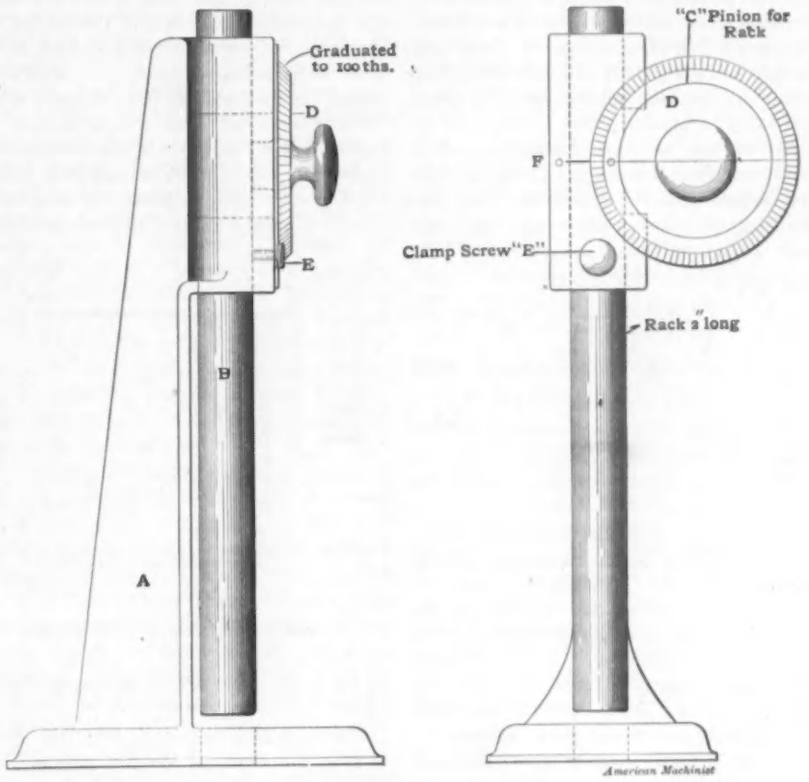
W. H. SARGENT.

St. Johnsbury, Vt.

A Hight and Depth Gage.

Editor American Machinist:

I send you herewith sketch of a gage which may be used either for a hight or a depth gage. It consists of a standard *A*, having a suitable base, and at the top two bearings which admit and guide the sliding stem *B*. This stem has a rack cut on one side, which rack may be of any desired pitch. Into this rack is geared a pinion C, which in turn is attached to the knurled dial-plate *D*. This plate has on its edge graduations, say, one-hundredth of an inch apart, and spaced through a sufficient portion of the circumference, so that the rotation of the plate and pinion within the range of the graduations will raise or lower the stem a distance of 2 inches, or any other amount, as it may be constructed. The pinion may be of any diameter and pitch, but the selection of the pitch must be made, and the graduations of the dial D so determined, that the movement of the stem can be registered in inches and fractions of the same. A screw *E* clamps the stem when set. By substituting a longer stem this tool can be used as a depth gage with equal facility. The readings are from the zero mark at *F*. This gage may be of use to some of the craft.



A HIGHT AND DEPTH GAGE.

C. A. BURTON.

Kansas City, Mo.

Turning a Crank.

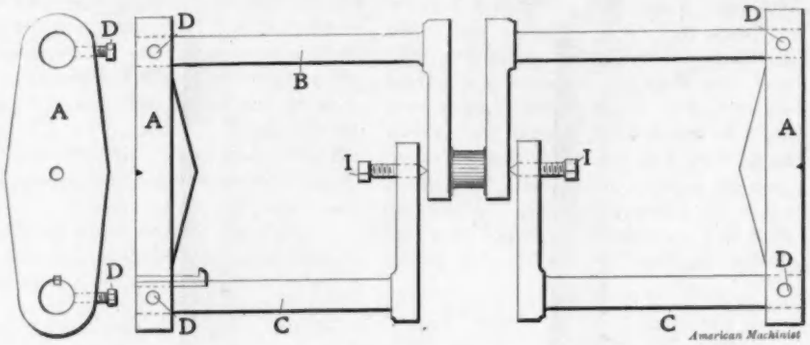
Editor American Machinist:

Having received so many valuable "pointers" from your paper, I am tempted to offer the following as a very small recompense: In your March 2 issue was a description and good photos of a rig used by Struthers & Wells for turning center cranks. The sketch enclosed shows a rig I have used for the same purpose. I claim no part of the design, which may

be old, though I never saw it in your valuable paper.

A A are castings planed on the flat sides, and the two holes bored to receive the ends of the crank shaft, and spaced the correct distance from the center to give the crank pin the proper throw. *D D* are set screws to hold the crank shafts in proper position. *B* is a center crank for an engine in position to finish. *C C* are halves of a similar center crank shaft with the wrist pin removed. (We always take a broken or condemned crank shaft and cut out the wrist pin.) *I I* are hard steel set screws pointed and tempered on their points.

Our method of using the rig is to first rough out the crank shaft all over to 1-16 inch larger than the finish size, then cut two slots in slotter about ¾ inch wide



RIG FOR TURNING CRANK PINS ON CENTER CRANKS.

back to the wrist pin. We then take the crank out to the steam hammer and with a big chisel cut out the piece between the slots. It is then ready to turn the wrist pin. With a surface gage and a flat plate we lay out and center punch holes for the pointed set screws, and put on the castings, tighten up all the set screws and commence cutting, and ten minutes is time enough for changing the rig. For the first crank turned you will have to center the crank, but all afterward are ready centered by the pointed set screws.

If the cranks have a large throw, we put a key in *C* and in the casting *A* to make it perfectly solid, but the key only to fit on the sides. Small-throw cranks do not need a key.

Where the crank shafts are of different sizes in the shaft part, but with the same throw, we bush the castings *A* and have no trouble, except having to add some balance weight. One can see this rig does not distort the shaft, holds it firm, and, with shafts of the same size, the crank is in perfect balance, so that the lathe can be run at any reasonable speed to file and polish if necessary. T. B.

The Atbara Bridge.

The quick production and shipment of the Atbara bridge by the Pencoyd Iron Works seems to have astonished our British friends more than anything that we have previously done. Mr. Rigby, of the English firm of Rigby & Westwood, is quoted as follows:

"I simply do not believe that any firm in the world can turn out a bridge of that size in the time mentioned. We and other British firms made special efforts to secure this particular contract. At a meeting of our directors, who are all connected with large steel-mills, it was agreed to divide the supply of the requisite material and let orders wait. We made a very low tender, guaranteeing to deliver the bridge by April 30, but no tenders of British firms were even acknowledged. Of course a bridge has undoubtedly been shipped from Philadelphia, but I absolutely decline to believe that the work on it was commenced on February 8. The American firm either had the specifications before or adapted a standard bridge to suit the requirements of the case. No other explanation is possible."

This is easily disposed of by Mr. Roberts, of the Pencoyd Works, who says:

"I scarcely need say that there was nothing underhand about our securing the contract. We had no specifications in advance or any advantage over English firms. But Mr. Rigby's remark that no firm could turn out a bridge of the size needed in the time we have will make American bridge builders smile. Instead of preparing the work in seven weeks, we could have done it in seven days if absolutely necessary. Englishmen require too much time for thinking in the bridge-building business."

The Washington Meeting of the American Society of Mechanical Engineers.

The complete programme is published for the spring meeting of the American Society of Mechanical Engineers. This, the thirty-ninth meeting of the society, will be held in Washington, D. C., May 9 to 12, inclusive. The professional sessions of the society will be held in the assembly room of the Arlington Hotel, which house will be the society headquarters during the session.

Tuesday afternoon, May 9, will be left free for the assembly of members in the city, and for individual visits to points of general interest.

The opening session and informal reception by the President and officers of the society, will, by the courtesy of the Board of Trustees, be held in the new Corcoran Gallery of Art. There will be an opening address of welcome, with special reference to Washington Monument, by Col. T. A. Bingham, United States Engineers, in charge of public buildings and grounds.

The business session for the reports of tellers, for the consideration of the Code for Conducting Boiler Trials and for general business, will occur on Wednesday morning, and when those matters are disposed of, the reading and discussion of professional papers will be taken up, according to the list at the end of this notice.

On Wednesday afternoon the society will be received by President McKinley in the Executive Mansion.

The session of Wednesday evening, and also that of Thursday morning, will be devoted to the reading of professional papers.

On Thursday afternoon the members will meet at the Navy Yard gate at 2:30, to visit the gun factory, the trial tank for ship models, the Ordnance Museum and the ships.

On Thursday evening a reception is tendered to the society by Mrs. George Westinghouse.

The closing session will be held on Friday morning. In the afternoon there will be an excursion to Mount Vernon, and in the evening a visit to Washington Monument, which will be lighted for the occasion. A visit will also be made to the Congressional Library on Capitol Hill. The building will be brilliantly lighted, and opportunity will be given to see in operation the lighting and ventilating machinery and the book conveyors, under the personal guidance of Mr. Bernard Green, superintendent..

The Washington members desire the visitors to avail themselves to the utmost of the present opportunity, and propose to send to each member, who expects to attend the convention, a presentation copy of the Standard Guide of Washington. For this purpose, and to secure the study of Washington's attractions in advance of the meeting, members are requested to advise the Local Committee at once of their intention to attend.

Arrangements have been made whereby special facilities will be afforded members in visiting the public departments, museums, private art galleries and other points of interest in the city. Announcements will be made during sessions.

The privilege of the Army and Navy and the Cosmos Club houses has been extended to members during their visit.

Washington being a "wheelmen's paradise," all are urged to bring their bicycles.

This is a programme bristling with enticements, and the attendance cannot fail to be unusually large. Arrangements have

been made with practically all railroads for transportation on the certificate plan at two-thirds of the regular rates.

The following is a complete list of the papers to be read:

Wednesday morning: Stanwood, J. B., "Standards for Direct-Connected Generating Sets" (No. 825); Hale, R. S., "Boiler and Furnace Efficiencies" (No. 821); Emory, F. L., "Test of a Steam Separator" (No. 815); Henning, Gus C., "Investigations of Boiler Explosions" (No. 818).

Wednesday evening: Emory, F. L., "Relation Between Initial Tension and Power Transmitted by a Belt" (No. 816); Newcomb, C. L., "Experiments on Various Types of Fire Hydrants" (No. 813); Bissell, G. W., "Experiences With Deep-Well Pumping Rods" (No. 817); Nagle, A. F., "Pipe Flanges and Their Bolts" (No. 811); Henderson, George R., "Manufacture of Car Wheels" (No. 810).

Thursday morning: Bolton, R. P., "Equipment of Tall Office Buildings in New York City" (No. 824); Bull, Storm, "The Central Heating Plant of the University of Wisconsin" (No. 823); Darling, E. A., "The Power Plant of a University" (No. 822); Alden, G. I., "The Plunger Elevator" (No. 808); Pratt, C. R., "Elevators" (No. 814).

Friday morning: Quereau, C. H., "The Allen Valve for Locomotives" (No. 820); Fritz, John, "Rolling Mill Fly-Wheels" (No. 819); Gordon, F. W., "New System of Valves for Steam Engines, Air Engines and Compressors" (No. 812).

Obstacles to Exporting Machines to Germany.

The following extracts from a consular report recently received from the United States consul at Dusseldorf, Germany, should be of interest to those of our readers who are interested in the export of machinery. There is no doubt that many American machine constructors have much to learn regarding the proper packing of machinery for sea shipment:

"This consulate is frequently called upon to assist in the adjustment of annoying controversies between American manufacturers of machinery and tools and their German customers, arising from damage to goods in transit, delays in shipments and vague contracts. These difficulties, unless guarded against more carefully, will become very serious obstacles to the progress of this important and rapidly increasing item of American trade in Germany. Damage to machinery and machine tools in transit has been very frequent, and I have just seen one shipment in which three very valuable machine tools were completely ruined, the cast-iron frames being broken in several places. It is impossible to ascertain whether the damage was done by the railways in America, the steamship companies or by the railways in Germany. Nobody seems to be responsible. It is alleged, however, by those interested that these heavy machines are subjected to very rough handling by the steamship companies. It is said that they jerk them out of the vessels with steam cranes, often hooking to frail castings which are not strong enough to sustain the weight. Before accepting damaged machines, the German buyer examines them while in the possession of the railway at the final destination, and they are also exhibited to witnesses before being taken from the depots, resulting in protested drafts, long and disagreeable disputes, and sometimes expensive lawsuits. Delay in the delivery of machines has also in several instances resulted in heavy losses. In one case, an apparatus valued at over $3,000 was to have been delivered in October, but did not reach Germany until the following February. It had been sold by a German house dealing in American machines, with the agreement that it was to be delivered in November. The result was a suit against the dealer, in which damages for about $2,000 were demanded, and, in turn, the middleman claimed similar damages against the American manufacturer.

"To prevent breakage during shipment, all machines and parts of machines should be boxed, when possible, and the cast frames bolted securely to heavy timbers. In some of these machines, there can be no doubt that the castings are too light for export without careful packing. Contracts should be made in writing when practicable, and should leave no doubt as to where the responsibility of the exporter ends and that of the German importer begins. In several cases, I have found that the American claimed that his responsibility ended when he placed the goods aboard ship in New York harbor, while the German importer alleged that the goods were to be delivered here in good condition. These points should be fully covered in the contracts, and in cases where regular customers order by cable from catalogs, standing contracts covering all these points should be entered into. Much trouble will also be avoided by detailed specifications, and by the delivery of goods within the specified time. Care should be taken that the bills of lading show clearly that the machines are in good order, and forwarding agents should be given special instructions to carefully examine them at the seaports for cracks, bends and breaks, in order that the responsibility for damages may be easily fixed. While the transportation companies can be made to pay for goods damaged in transit, the shipper will experience many difficulties in compelling settlement where all of the acts are not clear, and where claims are resisted.

"Düsseldorf, being the financial center and largest city of the great iron and coal district of the German Empire, has become the leading place in the country for the sale of American machines and machine tools, and a number of firms employing large capital are engaged exclusively in the importation of these goods. Some of these firms—in fact, nearly all of them—remove the plates showing the names of the American manufacturers and replace them with plates bearing their own names as the makers. To avoid all of these difficulties and save the profit of the German middleman, a number of American manufacturing firms have opened permanent offices in this city, with American engineers in charge, where plans and specifications are prepared, estimates made and contracts entered into. This system is very much more satisfactory to both the manufacturer and the German firms which buy the machines for use. There can be no doubt that many other American machine-tool manufacturers could profitably increase their business by opening offices here, with competent engineers and solicitors."

Fire Apparatus in Russia—American Exhibit in St. Petersburg.

The underwriters state that the losses by fire in Russia every nine years equal the value of all the buildings in the Empire. While some of the larger cities have a paid fire department, they have no steam fire engines or chemical fire extinguishers, depending upon the old-style hand-brake engines and taking their supply of water from hogsheads hauled to the fire on four-wheeled wagons. Therefore Russia offers a market for steam fire engines, fire extinguishers, etc.

American manufacturers interested in Russian trade will be glad to learn that Secretary of the Interior Hitchcock has proposed to President McKinley and the Cabinet that the United States exhibit at the Paris Exposition shall be taken to Russia at the close of the Paris affair and exhibited at St. Petersburg as an independent exhibit. Mr. Hitchcock, when ambassador of this country to Russia, gave much time to studying business conditions in the Czar's dominions, and he is satisfied that a good exhibit of American manufactures and products in the Russian capital would awaken interest in the manufactures of the United States, which would lead to this country doing a great deal of business with Russia. It is believed that Secretary Hitchcock's suggestion will be carried out. A. F. T.

Assistants to Inspectors of Ordnance Wanted.

The United States Civil Service Commission announces that on May 9, 1899, examination will be held at any city in the United States where the Commission has a board of examiners, for the position of assistant to inspector of ordnance, Ordnance Department, Department of War.

The examination will consist of the sub-

jects mentioned below, which will be weighted as follows:

Subjects.	Weights.
(1) Letter writing (second grade).	10
(2) Penmanship	10
(3) Mathematics	10
(4) Practical questions	40
(5) Education and experience	30
Total	100

From the eligibles resulting from this examination certification will be made to the position of assistant to inspector of ordnance, South Bethlehem, Pa., and at Providence, R. I., Ordnance Department, Department of War, at a salary of $3 per diem each.

This examination is open to all citizens of the United States who comply with the requirements. All such citizens are invited to apply; but attention is invited to the fact that in making certifications to fill these positions preference will be given to those eligibles who are legal residents of the city or vicinity in which the appointment is to be made. Subject to this preference applicants will be examined, graded, and certified, with entire impartiality and wholly without regard to any consideration save their ability as shown by the grade they attain in the examination.

Persons who desire to compete should at once apply to the United States Civil Service Commission for application blanks (forms 304 and 394), which should be properly executed and promptly forwarded to the Commission, at Washington, D. C.

Growth of the Garvin Machine Company.

In connection with the sale of $200,000 7 per cent. cumulative preferred stock of the Garvin Machine Company, of New York, some interesting information is given out as to the history and business of the company. The business was established in 1862 and incorporated in 1889, and has always been the manufacture of machine tools and machinery. The original limit of capitalization was $100,000, upon which the company has earned net, annually, for the past nine years, 46 per cent. The works have been practically destroyed twice by fire, but the business has grown so that an increased capitalization has become necessary. The total capitalization is now to be $500,000, divided into 2,000 shares preferred and 3,000 shares common. The entire net proceeds from the sale of the $200,000 preferred stock goes into the company's business. The $300,000 common stock of the company is held exclusively by the former owners of the original stock, and is not for sale. The net earnings for nine years equal 7 per cent. per annum for the total preferred stock and 10 per cent. for the common stock. The assets of the company at the close of 1898 exceeded its liabilities by $418,699.97. The plant of the company is located in one of the most substantial and modern buildings in the city, the property of the Trinity corporation. The estimated value of the present plant is given as follows:

Machine tools, requiring power to operate	$127,803
Movable tools, jigs, reamers, cutters, dies, etc	35,000
Drawings, tracings and patterns	33,000
Factory fixtures, etc	17,600
Total	$213,403

Personal.

The Chicago Pneumatic Tool Company will open an office in Boston, Mass., which will be in charge of Mr. J. M. Towle.

Mr. W. R. Warner, of Warner & Swasey, Cleveland, Ohio, recently sailed for Europe, his trip being taken in the interests of the company.

Marshall Halstead, United States Consul at Birmingham, England, is home on a visit, and will see as many as possible of the American machinery builders who are doing business in England.

F. J. Smith, who for about twenty years has been associated with the S. W. Card Manufacturing Company, has been elected president and general manager of the company, to succeed the late Mr. Card.

Mr. W. P. Pressinger, recently of the Clayton Compressor Company, has accepted a position with the Chicago Pneumatic Tool Company, in connection with the New York office of that concern.

The resignation is announced of William

(*Continued on page 41.*)

Miscellaneous Wants.

Advertisements will be inserted under this head at 25 cents a line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Gear Wheels, gear cutting. Grant; see p. 16.

Caliper cat. free. E. G. Smith, Columbia, Pa.

Forming lathes. Mer.Mach.T.Co.,Meriden,Ct.

The Dutton Wet Twist Drill-Grinder is sold by the Garvin Machine Co., New York City.

For Sale—Drawings, patterns, etc., for modern gas engine. Box 247, AMER. MACH.

Light and fine mach'y to order; models and elec. work specialty. E. O. Chase, Newark, N. J.

Book "Dies and Diemaking," price $1, post paid. J.L.Lucas,Prov.,R.I. Send for index sheet.

For Sale—The whole or one-half interest in a well-established machine shop. Box 245, AMERICAN MACHINIST.

"Brandt's Triple Expansion Gaskets" are the best for boilers. Randolph Brandt, 38 Cortlandt st., New York.

For Sale, Cheap—Second-hand engine lathe, double end, 22-ft. bed, 26 and 38-in. swing. Box 203, AMERICAN MACHINIST.

Bound volumes of "American Machinist" for 1893 and 1894, cloth, good condition, $3 each; one of 1888, morocco, $4. "Volumes," care AMERICAN MACHINIST.

Best workmanship; reasonable charges; watch, clock and other light machinery; send for samples of punch and die work. Waltham Machine Works, Waltham, Mass.

Wanted—Manufactured machine-tool appliance; West preferred; $35,000 ultimately required; improved staple article; big demand; good profit. Box 249, AMER. MACH.

For Sale—Machine shop in Cincinnati, fully equipped for manufacturing 12 to 18-inch engine lathes, and employing 20 hands. Walter Schlotman, 600 East Third st., Cincinnati, Ohio.

Wanted—Partner in marine and mill machine shop plant located on water front and railroad at Tacoma, Wash.; all work on hand plant can do; reason for selling, insufficient capital to handle business. J. O. Bradney, Tacoma, Wash.

Institutions retiring from business having machine tools, brass or wood working machinery will find it to their interest to correspond with us. We purchase complete plants or handle them on com. C. C. Wormer Mach. Co., 55-59 Woodbridge st., W., Detroit, Mich.

Wants.

Situations and Help Advertisements only inserted under this head. Rate 25 cents a line for each insertion. About six words make a line. No advertisement under two lines accepted, and no advertisements abbreviated. The cash and copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded. Applicants may specify names to which their replies are not to be forwarded; but replies will not be returned. If not forwarded they will be destroyed without notice. Original letters of recommendation or other papers of value should not be inclosed to unknown correspondents.

Situations Wanted.

Mechanical draftsman would like to change position. Box 255, AMERICAN MACHINIST.

Draftsman for engine, marine and general machinery, seeks position. Box 264, AMERICAN MACHINIST.

An experienced foreman on engines and general machine-shop work desires position. Box 266, AMERICAN MACHINIST.

Experienced designer, successful at reducing inventors' experimental ideas to shop and commercial practice. Box 268, AMER. MACH.

As foreman on brass work; thorough, practical experience and good executive ability. Address Alfred, 80 Messer st., Providence, R. I.

Wanted—Position as foreman of machine shop, by a thorough, practical mechanic, one who can handle men. Address Box 260, AMERICAN MACHINIST.

Competent draftsman would like to make drawings and designs for special machinery at his home and after office hours. Box 254, AMERICAN MACHINIST.

Draughtsman, 31 years of age, with 10 years' experience on steam engines and complete steam plants, would like change. Box 256, AMERICAN MACHINIST.

Mechanical draftsman of 26 desires to quit the board; has had excellent commercial experience in mechanical line; of good address; A1 references. Box 261, AMER. MACHINIST.

Wanted—Management or responsible connection with Boston office of firm or corporation; scientific education, character, energy and wide acquaintance. G. M. Warren, West Newton, Mass.

A foreman pattern maker wants an engagement; is middle aged; has had charge of a large number of men for the past 20 years on all kinds of special machinery; best of references furnished. Box 258, AM. MACH.

Young man, technical education, 4 years' varied experience, knowledge of several European languages, desires to change, position as draftsman, assistant master mechanic, or to represent; references. Box 265, AM. MACH.

By a young man who thoroughly understands "buying" shipping, both foreign and domestic, and handling of men; has had 12 years' experience in a large manufacturing company; at present employed; personal reasons for making a change. Address Box 259, AMERICAN MACHINIST.

Mechanical engineer and draftsman, technical graduate, several years' experience about rolling mills, steel plants and heavy machinery, familiar with structural work, and can compute stresses in machines and structures, able to take charge of drawing room, or assistant to chief engineer, desires to correspond with desirable concern for permanent situation. Address Box 263, AMERICAN MACHINIST.

Wanted—A position as toolmaker with a manufacturer of screw-machine product, in any country, by an American, 34 years of age, speaking English language only; a graduate of Rochester Athenæum and Mechanics' Institute; experienced in a variety of small manufacturing; one year in England; best of references; applicant would like to connect himself with a reliable firm to show his ability, with prospects of representing them at World's Fair, and solicits correspondence. Box 269, AMERICAN MACHINIST.

Help Wanted.

Wanted—An expert for estimating and laying out gear work. Address "Gear," A. MACH.

Wanted—A mechanical draftsman being familiar with the best heavy machine-tool prac-

tice; must be rapid and accurate. Address H. G. M., care AMERICAN MACHINIST.

Wanted—First-class foreman for shop building heavy general machinery; one familiar with piece work; state experience. Address Box 250, AMERICAN MACHINIST.

Wanted—Experienced tool maker conversant with the manufacture of fret-saw blades; give full particulars as to experience, age and wages required. Box 262, AMER. MACHINIST.

Wanted—A first-class lathe hand, familiar with printing-press cylinder work; also general machinists. Address, stating age and qualifications, Taunton Locomotive Mfg. Co., Taunton, Mass.

Machinists wanted by engine builder located in the neighborhood of New York; skilled men only, to work on all-night gang; write concerning ability and pay expected. Address Box 230, AMERICAN MACHINIST.

Wanted—First-class machine and floor hands, by machine and engine works, Central Pennsylvania; steady employment, good wages and cheap living; state previous experience. Address Box 257, AMER MACH.

Wanted—Five or six good machinists and one blacksmith, to increase our force in machine shop building hoisting and haulage engines for coal mines. In applying give full particulars as to experience and age to Kenney & Co., Scottdale, Pa.

Wanted—A first-class head draftsman who has had thorough technical education and shop experience; our work is mainly Corliss engine work, but prefer man with ice-machine experience; position open now; state experience; give references. Address Box 267, AMERICAN MACHINIST.

THE TALK OF THE WORLD!

The latest sensation in scientific circles is the appearance of the new practical work by T. O'CONOR SLOANE, entitled . . .

"LIQUID AIR"

AND THE

LIQUEFACTION OF GASES.

It is a logical explanation and application of the principles of liquefaction, a history of the theory, discovery and manufacture of liquid air.

A book that renders simple one of the most perplexing chemical problems of the century. Startling developments illustrated by actual experiments.

Seventeen absorbingly interesting chapters. 360 pages, profusely illustrated. Copious index to subjects. Octavo. Printed on excellent paper.

Copies prepaid to any address on receipt of price, or special circular of contents sent on request.

PRICE, $2.50.

NORMAN W. HENLEY & CO.,

Publishers,

15 BEEKMAN ST., NEW YORK.

Machines Designed to Order.

That's my business, helping other people out of difficulties. I'm one of those Connecticut Yankees that—well, that make things work.

L. H. BLOOD, 49 Pearl St., Hartford, Conn.

CLEVELAND GEAR WORKS,
W. R. SAWYER, Lessee.
88 SENECA STREET,
CLEVELAND.

GEARS of all descriptions

IMMEDIATE DELIVERY.

Latest Improved Upright Drills.

7—20″ Wheel and Lever Drills.
3—20″ Wheel and Lever, Back Geared.
1—21″ Wheel and Lever, Power Feed.
4—24″ B. G. P. F. A. S.
3—28″ B. G. P. F. A. S.
1—40″ B. G. P. F. A. S.

The Lodge & Shipley Machine Tool Co.,

CINCINNATI, OHIO.

The CROSS OIL FILTER

actually reduces oil bills 50% or more. Sent on approval. Capacities 3 to 150 gals. per day. Used in 23 countries. Testimonials from the leading firms in every field of industry.

THE BURT MFG. CO.
AKRON, OHIO, U.S.A.
Business Established 9 Years.
Largest Manufacturers of Oil Filters in the World.

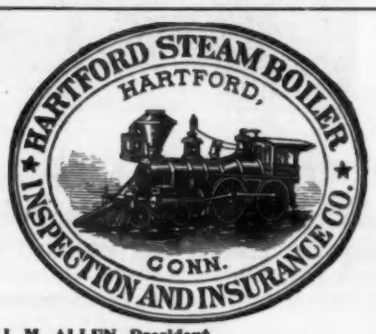
FAINT HEARTED

is the man who, realizing that success in the engineering profession is impossible without a technical training, and having been unable to secure such an education, gives up and remains in a subordinate and low salaried position. You can obtain a thorough technical education at home. Courses by mail in

Mechanical, Steam and Electrical Engineering, Mechanical Drawing and Machine Design. Best Text Books and Drawing Plates Free.

Seven years of experience in teaching by correspondence. Write for our illustrated Circular T, sample pages of text books, drawing plate and booklet of letters from students all over the world.

The United Correspondence Schools,
154, 156, 158 Fifth Ave., New York.



J. M. ALLEN, President.
WM. B. FRANKLIN, Vice-President.
F. B. ALLEN, Second Vice-President.
J. B. PIERCE, Secretary.
L. B. BRAINERD, Treasurer.
L. F. MIDDLEBROOK, Assistant Secretary.

INVITATION

to call on us and inspect our New Quarters. We will show you a full line of . . . . . .

Tools, Files, Machinery. Cash Buyers Like Our Prices

THE FRASSE CO., 38 Cortlandt Street, New York.

(*Continued from page 40.*)

Buchanan, superintendent of motive power of the New York Central Railroad. Mr. Buchanan's services to this road and the original elementary portions of it cover a period of fifty-two years. Mr. Buchanan worked on the De Witt Clinton, and the famous "999" was built under his administration, so that he is identified with both the beginning and the up-to-date development of the American railroad. Mr. Buchanan retires as one of the foremost railroad engineers, and he is one of the few Americans who have been honored by membership in the Engineering Association of Great Britain.

Obituary.

James L. Hodson, of the firm of G. & J. Hodson, machinists, of Philadelphia, died April 17; sixty-four years old. Mr. Hodson was born in England and came to this country when seven years old with his parents. He learned the machinists' trade, and for thirty-seven years was in partnership with his brother, who died in February of this year.

John Louis Lay, an assistant engineer of the United States navy during the Civil War, who devised the torpedo with which Cushing destroyed the Albemarle, and was the inventor of the well-known Lay torpedo, died in this city, April 17. Mr. Lay resigned from the navy in 1867; was later in the Peruvian service, and then lived in Europe for several years. Although he is understood to have had considerable money at one time, he died in extreme poverty.

Technical Publications.

"Stevens' Mechanical Catechism," by H. G. Stevens. 435 4x6-inch pages, with numerous illustrations. Laird & Lee, Chicago. Price $1.

In the slang of the day this book is a bird—a whole flock of birds, in fact. As a mirth provoker it belongs in the same category as "English as She is Spoke." Artemus Ward, Mr. Dooley in "Peace and War" and the circus are outclassed by it. The only modern literary work with which it can be compared is to be found in the attempts of the daily newspaper press to deal with scientific and mechanical matter—choice gems from which appear in our columns occasionally. A few selections taken at random will enable our readers to form their own ideas of the merits of the book, which is largely in the question and answer style.

"Q. Why is steam called latent heat?" [Don't all speak at once.]

"Q. What is it that ruptures a boiler? A. Unequal expansion and contraction."

After giving instructions for setting the eccentric of a slide valve engine so as to reverse the motion, our author remarks "This will bring the eccentric around on

the shaft one-quarter of the circumference."

"Q. At what angle does the highest pitch-line of an eccentric lie to the level of the crank pin at dead center?" [As the "pitch lines of eccentrics" is a subject which is peculiarly the author's own, it is a pity that he has not elaborated it more fully.]

While elucidating the subject of cut-off and expansion, using an engine of 24-inch stroke for illustration, the following occurs:

"Q. How many expansions are there in our case? A. At the half-stroke 12 inches or the double, at 18 inches the threefold, and at 24 inches the fourfold expansion."

"Find the area of the face of the piston head, multiply the answer by piston speed in feet per minute and divide by 33,000; the answer will be the nominal horsepower. For the actual or effective horsepower, take two-thirds of the quotient."

After finding the diameter of a pump piston to deliver 324 gallons per minute, neither water nor steam pressure being named, the course of instruction proceeds thus:

"Q. What size should the steam cylinder be, as compared with the pump cylinder? A. One-third larger in diameter."

After learning of the existence of iron in the sun, we are asked: "Q. How can this be known? A. *Spectral* analysis reveals the fact."

The following account of the means by which liquid air is produced is almost as good as much of the information coming from more original sources: "By the aid of a 50 horse-power steam air pump, ordinary air is compressed until it becomes red-hot. Then it is cooled in submerged pipes, and is further compressed until the pressure is registered at thousands of pounds to the square inch. [Heavens!] More cooling is done and more pressure applied, until finally the air liquefies. *It oozes through the steel of the pipe* in the shape of milky vapor and trickles down into the receptacle below."

"A teaspoonful of liquid air in a closed vessel, if lighted, explodes with tremendous force, jarring the ground like an earthquake." [My!!]

"Guns using liquid air as an explosive would never get hot." [True, beyond a doubt.]

"Q. Name the different kinds of levers. A. Force, weight and fulcrum." [The whole science of mechanics in three words.]

As an example of worthless book-making, this effort heads the list of all that we have seen.

Inquiries for Machinery.

(100) For names and addresses of makers of calliopes (steam organs).

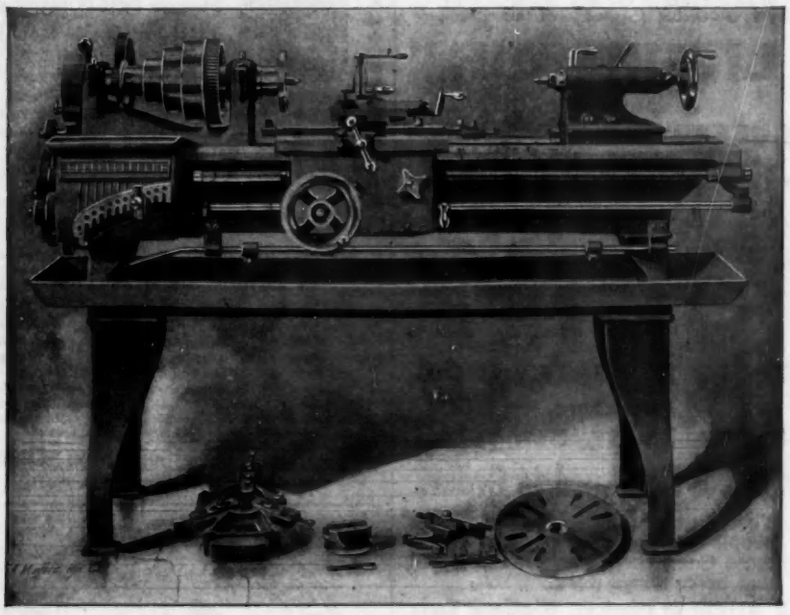
(101) For machinery used in the manufacture of clay pipes.

The Hendey Machine Co.

TORRINGTON, CONN.

This Company is the sole owner of Letters Patents Nos. 470,591, 519,294 and 549,006, granted to W. P. Norton for Improvements in Engine Lathes.

We take this method of notifying the public that we have already commenced suit against infringers of these patents, and that should it be found necessary to the protection of our rights, additional suits will be brought against manufacturers, vendors and users of infringing lathes.



The merits of these improvements have been widely recognized and have been wantonly copied. We shall take vigorous steps to protect our own.

The Hendey Machine Co.,

TORRINGTON, CONN.

AGENTS FOR THE PACIFIC COAST:
Pacific Tool and Supply Co., San Francisco, Cal. J. W. Cregar, Philadelphia Bourse Exhibition.

EUROPEAN AGENTS:
Schuchardt & Schütte, Berlin, Vienna, Brussels, Stockholm. Chas. Churchill & Co., London and Birmingham, England. Adolphe Janssens, Paris, France.

76,800 DAILY PRODUCTION
5 FACTORIES
5 BRANDS

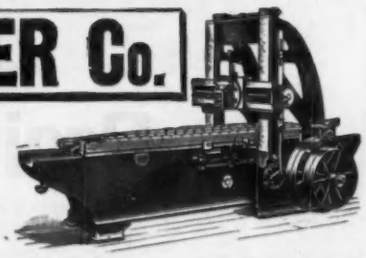
NICHOLSON FILES.

16 Governments
85% R.R., 70% U.S. Contracts
70% of Total Production of America

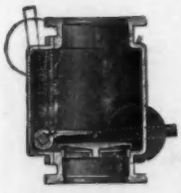
FOR SALE ALL OVER THE WORLD.
NICHOLSON FILE CO., Providence, R. I., U. S. A.

POWELL PLANER Co.

WORCESTER, MASS.



U. Baird Machinery Co., 125 Water St., Pittsburgh, Pa.
Robinson & Cary Co., St. Paul, Minn.
W. R. Colcord Mchy Co., 502 North 2d St., St. Louis, Mo.
Parke & Lacy Co., Fremont St., San Francisco, Cal.
The Fairbanks Co., 705 Arch St., Philadelphia, Pa.



Excelsior Straight-Way Back Pressure Valve.

This valve has no dash pots, springs, guides or complicated levers to get out of order. It is simple, reliable and well made. Never sticks, and can be relied upon at all times when using exhaust steam for heating; or when used as a relief, or free exhaust on a condensing plant, it has no equal. It is noiseless and free from any complicated attachments.

Jenkins Brothers, New York, Boston, Philadelphia, Chicago.

STEAM BOILER PRACTICE IN ITS RELATION TO FUELS AND THEIR COMBUSTION
AND THE ECONOMIC RESULTS OBTAINED WITH VARIOUS METHODS AND DEVICES.
By WALTER B. SNOW, S.B., Member American Society of Mechanical Engineers. First Edition. First thousand. x + 297 pages; 24 figures. 8vo. Cloth, $3.00. *Order through your bookseller; or copies will be forwarded, postpaid, by the publishers, on the receipt of the retail price.*

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If you are using emery or corundum for grinding or polishing you are not making as much money as you might.

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has several times the efficiency of emery. That means that one pound of Carborundum will polish several times the number of square feet of granite that one pound of emery will. Carborundum never case-hardens saws.

THE CARBORUNDUM CO., NIAGARA FALLS, N.Y.

For Fifty-three Years We've Made Machine Tools.

In those fifty-three years we've learned a great deal—much that people who are younger in the business have got to learn before they can hope to equal our product. Among other things we have learned the machine tool requirements of the best shops, have learned what to do in order to meet them, and, what is sometimes of greater importance, have learned what not to do.

One of the results of our wide experience and careful study is our No. 2 Cabinet Turret Lathe—a Lathe that we sincerely believe will turn out more and better work than any other. We haven't room here for a detailed description of this Lathe, but we would be glad to send it to you, and it ought to pay you to ask for it.

American Tool & Machine Company,

109 BEACH STREET, BOSTON, MASS.

FOUNDED 1845. INCORPORATED 1864.

The early example of a steam engine by James Watt, till recently at work in Dundee, but acquired as a memorial and example of old-time engineering by public enterprise, is now about to be housed and set up in the Barrick Buildings, Dundee, where it will be in a situation well adapted to its preservation and to free inspection of all interested. The cost of housing and erecting the engine will amount to £500, and the fitting up will be done in such a way as to admit of electric motor power being applied for putting it in motion if at any time desired.—"The Engineer."

Stanley H. Moore, director of manual training of the Manual Training High School, Kansas City, Mo., informs us that it is the intention of the school to fully equip with the latest and best tools, new pattern, molding, tin, forge and machine shops, and would be glad to receive catalogs and other literature from builders of machine tools.

When acetylene gas is burned with a smoking flame it produces three or four times as great a quantity of soot as do the mineral oils. It is very light and exhibits an absolutely black color without a tinge of brown. It is also very bulky, and is admirably adapted for India ink and for fine inks for lithographic work.

It is estimated that during the present year 5,000 miles will be added to the total railroad mileage of the United States. This means the investment of $150,000,000, and the permanent employment of 25,000 men. There are 590 new lines projected or under construction, with a total length of 40,563 miles.

Eighty-two fires have been caused in New York city since January 1 by defective flues. Some old machinist might be able to give the builders points about making tight joints.

Manufacturers.

Flather & Co., Nashua, N. H., are erecting additions to their plant.

The Fellows Gear Shaper Company, of Springfield, Vt., is contemplating additions to their shop which will about double the capacity of the plant.

The Acker Process Company, of 56 Essex avenue, Jersey City, N. J., will erect a chemical manufacturing plant and machine shop at Niagara Falls, N. Y.

Edwin Upton has purchased the interest of C. A. Adams in the Gardner Nickel Plating Company, Gardner, Mass. He will enlarge the plant and make other improvements.

It is reported that the Scott & Williams Company, of Philadelphia, Pa., manufacturers of knitting-mill machinery, contemplates the erection of a mill at West Point, Ga.

Henry Sonnett, of East Palestine, O., will locate a pottery plant at Tiffin, O. **Work on**

the new structure will be begun as soon as material can be obtained, and the building will be pushed to completion.

The Manhattan Spirits Company filed plans and specifications with the Bureau of Building recently for a four-story brick factory, to be constructed on Fourth street, Buffalo, N. Y. The estimated cost of the building is $27,000.

The erection of the addition to the match factory, York, Pa., will be started at once. Contractors Gilbert & Co. have been given directions to commence the work. They will push the work as rapidly as possible. The addition will be 40 feet front and 80 feet wide, four stories high.

The P. & F. Corbin Company, of New Britain, Conn., has applied for permission to build an addition to its factories. The proposed addition will be 112 feet long and 42 feet wide. The hight will be six stories. It will be built of brick. It will be joined to the main factory and will be used for the extension of the regular business of the company.

The Utica Desk Company, of Utica, N. Y., has decided to remove its plant to Knoxville, Tenn. The operation of the new plant will be commenced within a short time. Messrs. G. S. Ballard and J. W. Howarth, members of the firm, are perfecting arrangements for the removal of the plant. The large manufacturing plant west of the city, formerly occupied by the Graves Mantel Company, is to be used.

New Catalogs.

The Swift Lubricator Company, of Elmira, N. Y., sends us catalog of sight-feed lubricators, injectors, valves, steam whistles and other brass goods. The catalog is 6x8¾ inches.

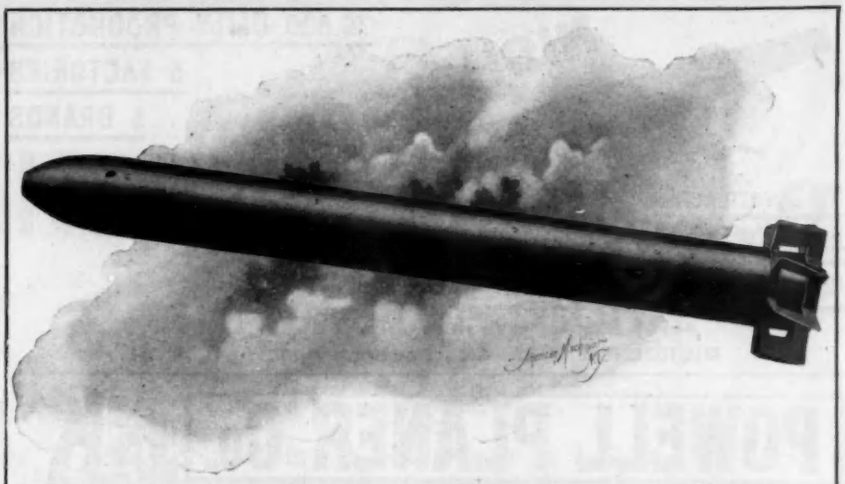
We are in receipt of catalog of windmills, tanks and pumps of Andrew J. Corcoran, 192 Broadway, this city. The catalog contains a number of very interesting views of windmills both for private and public purposes. The catalog is 8½x11 inches.

We have received from the Denison Electrical Engineering Company, New Haven, Conn., catalog devoted to the illustration and description of the Yale gas engine. The various parts of this engine are described in detail. These engines are made for both stationary and marine service. The catalog is 6x9¼ inches.

The Ingersoll-Sergeant Drill Company, New York, have issued a new booklet, entitled No. 25,000. The booklet derives its title from the fact that recently the company finished its twenty-five thousandth drill. Some interesting facts concerning the amount of work done by these drills are given. The catalog is neatly printed, and is 3¾x9 inches.

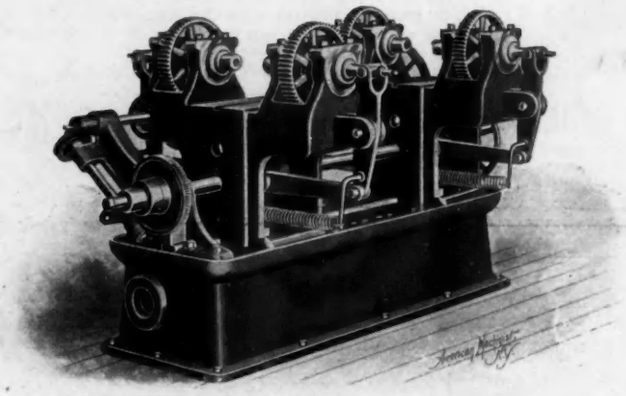
From the Westinghouse Machine Company, Pittsburgh, we have received catalog in which is described and illustrated the New Roney mechanical stoker. The details of construction of the stoker referred to are shown very clearly by means of sectional views. The catalog contains a number of illustrations of plants in which these stokers are used. The catalog is 6¾x9 inches.

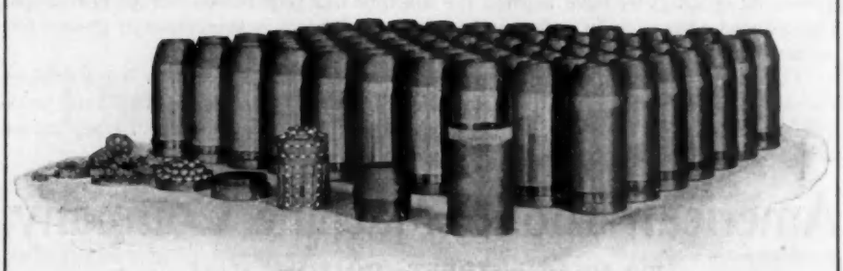
We have received from the Lane & Bodley Company, Cincinnati, illustrated catalog of what is known as the Columbian Corliss engine, and of which the company referred to is the sole builder. The different parts of these engines are described in detail, and the catalog contains a considerable number of illustrations showing parts and also complete engines. At the back of the catalog directions for the erection of these engines, adjustment of governors, valves and other suggestions, also a partial list of users, are given. The catalog is standard size, 6x9 inches.



Projectiles.

One of the important pieces of work that has been entrusted to us, was the making of a large number of Dynamite Projectiles and several thousand Schrapnel Shells for the Government. These were all accepted—not a single rejection—after the most rigid examinations and tests. We are ready to take other large contracts that require unusual facilities and great accuracy.



We are machine tool builders, too. We build machines of our own and special machines for others—the Milling Machine shown above is one of them. We are particularly successful in building special machines that require the greatest possible accuracy, having built such machines in which accuracy to the thousandth of an inch was requisite. We would be glad to correspond with you if you are interested.

A. Falkenau, 109-115 Nth. 22nd St., PHILADELPHIA, PA.